THE ILLUMINATING ENGINEER

LIGHT
LAMPS
FITTINGS
AND
ILLUMINATION

THE JOURNAL OF
GOOD LIGHTING

Official Organ of the Illuminating Engineering Society

FOUNDED IN LONDON 1908

Edited by
J. STEWART DOW

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ELECTRICITY
ACETYLENE
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ETC.

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Special Features:

Architectural Lighting—Decorative Lighting Out of Doors—A British Standard Specification for Photometric Integrators—Electric Lighting at Olympia—Light in the Service of Mankind—Novel Indirect Lighting Installations—An Essay on Street Lighting—News from Abroad, etc.

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The Curative Effect of Ultra-Violet Light

THE section of the annual report of the Medical Research Council commenting on the above subject has recently furnished the press with a lively topic, and has no doubt attracted more public attention than the authors anticipated. There can now, surely, be few members of the public who are quite unaware of the existence of this form of treatment! We should explain that the section entitled "Treatment by Artificial Light" occupies only about four pages out of a total of 165. But it deals with a subject that has captivated the public imagination, and has therefore been singled out for comment.

To readers of this journal the effects of both natural and artificial sunlight must naturally be of interest. Treatment by means of the sun's rays is of very ancient date. It was apparently practised by Hippocrates during the fifth century B.C. Even the application of artificial light cannot be regarded as exactly new, though it is only within the last few years that it has been applied in the form of "artificial sunlight" on a large scale. It is therefore only now for the first time becoming possible to form any accurate judgment of its possibilities.

An able survey of treatment by sunlight in Dr. Rollier's clinics and elsewhere was contributed to the Illuminating Engineering Society by Dr. C. W. Saleeby a few years ago.* We have hitherto assumed that the beneficial effects of sunlight were generally accepted, though Dr. Saleeby struck a note of caution in regard to the treatment with artificial light which has been echoed by others. The term "artificial sunlight" is, in fact, somewhat misleading, for the spectra yielded by illuminants rich in ultra-violet differ greatly, and cannot be regarded as identical with that of light from the sun. Nevertheless we should remember that natural sunlight is scarce in this country; hence the imitation of its effects by artificial means for winter treatment deserves consideration.

The general tenor of the report of the British Medical Research Council is undoubtedly discouraging to the use of "artificial sunlight." Two series of experiments on children in schools, conducted by Dr. Helen Mackay in 1925 and by Dr. Dora Colebrook in 1927-28, conveyed the impression that the results of the light were negative. Elsewhere it is remarked that "the use of artificial light to supply only what the right food can give is merely wasteful," and that equally good effects can be obtained much less expensively by the administration of cod-liver oil. Similarly, in regard to the function of creating an inflammatory reaction of the skin, it is suggested that "there is no present reason to know that artificial light can do more in this way than a mustard plaster, which is infinitely cheaper."

It is chiefly these two comments which have been seized upon by writers in the press who point out, with some justice, that exposure to artificial sunlight is at least an invigorating and pleasant experience which, if carried out under proper supervision, apparently leaves no ill-effects; whereas the drinking of cod-liver oil is, to most people, a penance, and the encasing of large sections of the body in mustard plasters is an inconvenient process, however beneficial to the system both may be.

In regard to sunlight, it is remarked "the Committee have found no reason for weakened confidence in the claims made by a number of distinguished clinical observers for the value of carefully regulated exposure of patients to natural sunlight, especially in such conditions as surgical tuberculosis . . . ." but "that there are other influences inseparable from this true heliotherapy . . . . . the relative importance of which, in comparison with the effects of the light itself, cannot yet be accurately appraised."

The report has met with some criticism, though possibly its intention may have been misinterpreted. In so far as it conveys a warning that the use of ultra-violet radiation should not be regarded as a "cure for all ills," and should be applied under competent medical advice, we agree. But we should be reluctant to accept an assumption, based on the few tests quoted above, that the method is valueless. Undoubtedly there are many physicians and medical officers who can furnish records of successful treatment.

That a great deal remains to be learned regarding the possibilities of artificial sunlight, that the qualities of radiation furnished by the various lamps require careful study, and that it should not be applied indiscriminately we may all agree. But it would seem unscientific to dismiss a method of treatment and discourage experiment until its possibilities have been fully explored. If treatment with ultra-violet light is indeed merely a "craze" it will disappear in time; if, on the other hand, it is of real value the medical profession as a whole will ultimately seek its aid.

* *The Illuminating Engineer*, July, 1925.

A Standard Specification for Photometric Integrators

THE recently issued British Standard Specification for Photometric Integrators* furnishes yet another example of the useful work on illumination now being done by committees working under the B.E.S.A. The specification relates to integrators either of spherical or cubical shape (the only permissible departure from the cube being the use of small fillets for constructional purposes) and of approximately 60 cm. (2 ft.) in diameter and upwards. An integrator of this diameter will serve for lamps not exceeding 130 mm. (approximately 5 ins.) in length. For larger lamps the integrator should be at least 4½ times the overall length of the lamp (exclusive of the cap). The dimensions of integrators suitable for testing translucent glassware and reflectors will be found in the specifications relating to such fittings (Nos. 324 and 232). The size and position of the translucent window are specified and detailed instructions are given for the correct positions of the test lamps or luminous sources and the screens designed to prevent the window from receiving any direct light. A useful feature in the specification is the formula given for the paint used to coat the interior of the integrator, the reflection factor of which should be between 70 and 90 per cent.

The issue of a specification of this kind is a useful step. In the past an accurate photometric integrator was regarded as an expensive piece of apparatus, and the spherical type is not very easy to construct. But as, for most purposes, the cubical shape will answer quite well, the apparatus could be readily constructed in the workshop attached to most laboratories, now that the features essential to accuracy are made clear. One interesting point mentioned incidentally in the specification is the measurement of light from lamps with discoloured bulbs. For such lamps a larger integrator may be necessary. Generally speaking, it is desirable to make these integrators of generous dimensions, as errors due to possible inaccuracies are then reduced. This applies particularly to the testing of lighting units which are not only of relatively large size but more complex in construction.

One point on which one would like to receive further information—possibly this might be dealt with in an appendix to this specification—is the degree of accuracy attainable in measuring lighting fittings of an asymmetric type. When the polar curve of the source approaches reasonably near uniformity accurate measurements present no great difficulties. But how far the integrator can be trusted to give consistent results with lamps in highly concentrating polished reflectors, such as those used in projectors or, say, parabolic reflectors which give an asymmetric distribution, seems a little more doubtful. Theoretically the spherical form of integrator should perform its duties accurately even in these cases—such integrators have occasionally been used to measure the flux of light from a searchlight beam. But in practice one would imagine that one could not attain quite the degree of accuracy attainable with units giving a more or less symmetrical light distribution. It would seem, at all events, that in such cases the result of a departure to a cubical form would be somewhat problematical, and that it would be wiser to rely on the spherical type.

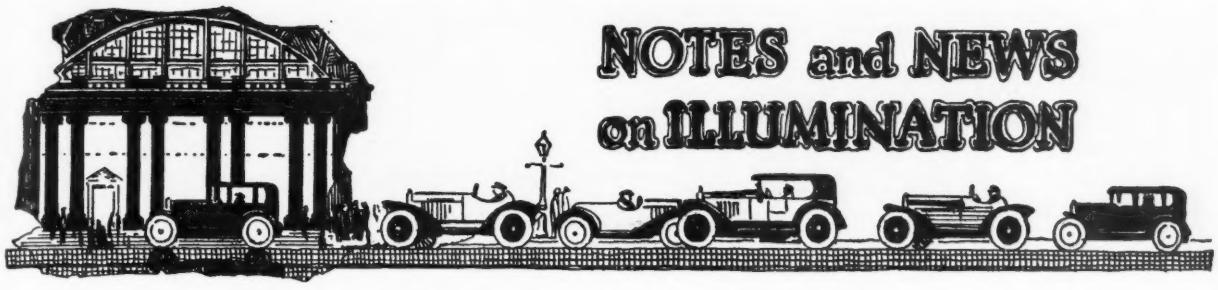
* British Standard Specification for Photometric Integrators, No. 354, 1929; obtainable from the British Engineering Standards Association, 28, Victoria Street, London, S.W.1; 2s. 2d. post free.

Decorative Lighting Out of Doors

A PAPER on the above subject, read by Mr. A. L. Powell before the twenty-second Annual Convention of the Illuminating Engineering Society (U.S.A.), and now reproduced in the Society's *Transactions*, contains some pleasing illustrations of the use of artificial light in parks and gardens. The methods adopted fall into three groups: (*a*) flooding interesting objects with white or coloured light, (*b*) illuminating water, and (*c*) the use of outline lighting or special luminous objects. All three methods are applicable to spectacular and decorative lighting in parks and exhibitions—they were used with good effect at the British Empire Exhibition at Wembley a few years ago. In private gardens, however, the first two methods are the most applicable, and it is, as the author remarks, a safe general rule that no light sources should be visible. Terraces, pergolas and attractive rock formations are good subjects for treatment, and lakes or small waterfalls have special possibilities. In some cases floodlighting in colour may produce pleasing effects, and the idea of colour changes naturally follows. The eye wearies of always seeing the same effect and craves for an occasional change. But the change should be capable of being made very gradually. Rapid fluctuations such as occur in luminous signs and shop-window lighting would hardly be acceptable. Generally speaking, the experimenter would be wise to exercise restraint and not attempt too much.

The application of artificial light in the garden is only a natural development in the present age of abundant light. Most of us have little leisure during the day. What more natural, therefore, than to make the most of the evening hours? Games and sport—tennis, badminton, etc.—tend more and more to become recreations of the evenings and artificial light has been applied to them with fair success. True, it is chiefly during the short days of winter that artificial lighting for this purpose is required, and few gardens repay inspection on a winter evening! But in the summer a stroll in the garden after dusk is often a delight and the skilful application of artificial light, coming as a surprise to guests, would tempt them to make more use of fine summer evenings.

It is, however, mainly in the parks and in grounds of exhibitions that the possibilities of what may be termed "horticultural lighting" lie. In exhibitions it is already a familiar feature. It has not always been exercised with great skill and originality in the past, but in the future, it is safe to say, its possibilities will be more fully realized. From all accounts the lighting of the grounds of the Barcelona Exhibition, mentioned in our last number, is likely to be something exceptional. It must also have struck many people that more might be done to render our parks attractive social centres by night. The Hyde Park sensation last year called public attention to the need for better lighting of the ordinary kind. Such lighting cannot, however, be considered in any sense decorative. It has often struck us how differently the fine stretches of water in many London parks would be treated abroad. There would, no doubt, be music and dancing and illuminated cafés round their banks. One could imagine what could be done with decorative lighting in skilful hands. We realize that there are difficulties—climatic and otherwise—but we cannot help thinking that much more might be done to encourage the enjoyment of the parks of London by night and to capture a little of the light-hearted gaiety of the outdoor life one finds in some cities abroad.



Illuminating Engineering Society

FORTHCOMING EVENTS.

The next item on the programme of the Illuminating Engineering Society, the meeting to be held in the lecture theatre of Holophane Ltd. on April 30th, occurs on the eve of publication of our next issue, and we must therefore defer the account of this gathering until our June issue. Dr. English's promised paper on " Some Further Properties of Glass and their Application in Illuminating Engineering " will no doubt prove a useful supplement to the interesting discourse which he gave last year, and members may also look forward to a demonstration of some novel applications of coloured light by Mr. R. G. Williams. We understand that there have been new developments since the demonstration of such effects given before the Society about two years ago. In the month of May there are to be two meetings. On May 14 Mr. G. H. Wilson will give a general survey of the International Illumination Congress held in the United States last year. On May 28th the Annual Meeting will be held, and the presentation of the usual report of the Council will be followed, it is hoped, by a demonstration by Dr. J. F. Crowley of some applications of synchronous intermittent light in the study of moving machinery.

Francis Bacon on Illuminating Engineering

In the *Transactions of the Illuminating Engineering Society* (*U.S.A.*) there appears a very apt quotation from Francis Bacon's " The Interpretation of Nature." In the course of his reflections on the selection of one's life-work he remarks:—

" Above all, if any man could succeed, not merely in bringing light to light some particular invention, however useful, but in kindling in nature a luminary which would at its first rising shed some light on the present limits and borders of human discoveries, and which afterwards, as it rose still higher, would reveal and make clear every nook and cranny of darkness, it seemed to me that such a discoverer would deserve to be called the true Extender of the Kingdom of Man, and the Exterminator of the necessities that now keep men in bondage."

Bacon's conception was doubtless metaphorical and applied to the illumination of the intellect of man, but it conveys a good picture of the task of the illuminating engineer, who may justly claim to have made substantial progress towards realization of this ideal.

The Field for Technical Societies

We are glad to see that Sir Alexander Gibb, in his recent Presidential Address to the Institution of Chemical Engineers, emphasized the value of the smaller specialized technical societies—a point that is, perhaps, not always fully realized by older bodies. One sometimes hears it said that there are too many technical societies, and certainly the number of meetings which a man with fairly wide interests feels it desirable to attend is continually increasing Yet the formation of new groups of specialists is an inevitable result of the progressive extension of scientific knowledge. The Illuminating Engineering Society, we believe, is now generally recognized to do useful work which could not well be handled by any other body, and we think that this applies to most, if not all, of the smaller scientific and technical societies of to-day.

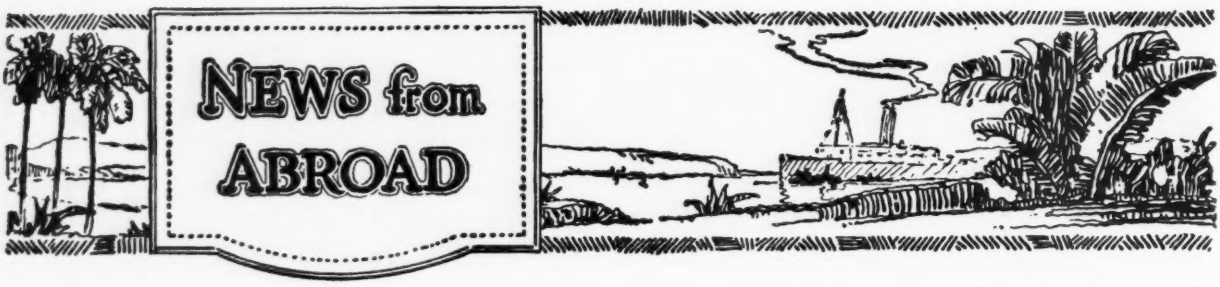
Accidents in Streets

The recently published official return of street accicents during the year 1928 reveals once more an increase. The number of fatal accidents in England and Wales attained 5,489, as compared with 4,761 in 1927; the total of all accidents was 156,024, as compared with 139,831. Even taking into consideration the clear relation between the total of accidents and the number of motor vehicles (referred to below), which, no doubt, also increased substantially last year, the figures are disturbing. The accident rate is naturally greatest in congested areas such as London. More rural areas, Kent County for example, make a better showing, and Margate and Rochester had the rare distinction of not recording a single fatal accident.

An analysis of accidents on highways, contributed by Sir Henry Maybury to *Safety First*, brings out several other interesting points. During the period 1921–25 the number of fatalities in Great Britain rose from 2,243 to 3,715. But meantime the number of mechanically propelled vehicles had also increased very considerably, so that the number of fatalities per 1,000 vehicles, 2.40 in 1925, was slightly less than in 1921. In the United States this ratio showed a more marked reduction, from 1.50 to 1.23, notwithstanding the considerable increase in total fatalities. The ratio in America is, however, much lower than in this country—a fact that is possibly explicable by the much greater area of the country and the lesser density of traffic on the roads. Fatalities may also be reckoned per 100,000 of population. On this basis we find, almost invariably, a steady increase in the figures, but New York comes out with almost double the accident ratio of London, which, in turn exceeds most of the provincial cities. In this article no attempt was made to divide night fatalities from those occurring by day. Similar calculations with fatalities thus divided might have yielded instructive conclusions. We recall that an analysis attempted in this journal some time ago suggested that night accidents have increased proportionately more rapidly than those occurring in the daytime—a conclusion which, if verified, would emphasize the importance of good public lighting in the interests of safety.

Model Street Lighting Installations

In his report on his visit to the United States last year Mr. Colquhoun recently described in some detail the " model street " utilized by the Edison Lighting Institute for tests of street lighting. Naturally these miniature installations cannot replace actual demonstrations in the streets, such as those organized in Sheffield last year. But they are excellent for purposes of demonstration, and much useful experimental work can be done with them. Experiments with model streets have also been made in this country. One was set up some time ago at the G.E.C. Research Laboratories at Wembley, and another was on view at the E.L.M.A. Lighting Service Bureau, when members of the Illuminating Engineering Society paid their last visit. With this model 14 different systems of street lighting can be quickly demonstrated, and it is also possible to vary the effect of " road surface " so that effects in wet and dry weather can be compared. Incidentally, the model can also be used to exhibit floodlighting, illuminated fascias, shop-window lighting, etc., and illustrates very strikingly how such supplementary concealed lighting aids the visual effect of public lamps.



Illumination and Letter Sorting

Readers may recall an instructive report on the influence of better lighting on the work of letter sorters in New York post offices, prepared by Dr. J. E. Ives in 1921–22. This enquiry indicated that higher illumination had a distinct effect on the speed of letter sorting, and the maximum efficiency was not reached until an illumination of the order of 8 foot-candles was attained. A further report, by Messrs. L. R. White, R. H. Britten, J. E. Ives, and L. R. Thompson, has now been issued.* This report confirms the previous conclusions in regard to the relation between illumination and efficiency—the time taken in sorting being reduced about 8 per cent. when the illumination was increased from 2.5 to 10 foot-candles. A useful feature of this investigation was the correlation of records of illumination and output with periodical tests of vision. About 50 per cent. of the operators tested wore glasses, so that a good opportunity was afforded of ascertaining whether any direct relation between visual acuity and lighting conditions could be traced. Practically all the clerks agreed that they found it easier to work under the higher illumination. Detection of actual ocular changes was apparently somewhat uncertain, but there was a definite improvement in visual acuity after the subjects had worked under high illumination for a sufficient length of time, and a corresponding decrease after working under low illumination.

Rural Highway Lighting

The lighting of rural highways has recently been exciting a considerable amount of attention in the United States. Many American cities, as British illuminating engineers had an opportunity of judging last year, are generously lighted. But Mr. Ward Harrison, in a recent article in *Light*, points out that on the intervening highways matters are very different. He instances the lights on Conneaut Bridge, spanning a valley on the outskirts of the city. County authorities, when erecting this fine bridge, installed lighting fixtures. But on asking the local central station to supply current they were met by the objection that the State legislation contained no provision for such a contract. In this case the difficulty was overcome, and the bridge is now well lighted, but, in general, the lighting of rural highways presents difficulties. Apparently few States have power to undertake such lighting, and property owners in the vicinity of Detroit, Albany and Cleveland, impatient of legislative provision, have paid for lighting installations by private subscription. In Great Britain there is not, we believe, any radical legislative difficulty in highway lighting. The difficulty is rather that the duty at present falls on the various rural areas through which an arterial road passes, many of which would find the expenditure an undue burden, whilst others consider that their obligations end at the outskirts of towns and villages, and that the needs of long-distance traffic should be met by the nation. There is, in fact, much to be said for this standpoint. In these days the lighting of main arterial roads, constructed for the national use, should surely be lighted at the national expense and on a uniform plan. Mr. Ward Harrison calculates that lighting forms only 1 to 1¼ per cent. of the road construction cost, and the benefits it confers by encouraging night traffic and relieving congestion during the day are out of all proportion to the expense involved.

* No. 181, issued by the United States Public Health Service.

Electric Light in Agriculture

We notice in *B.I.P.* an article reviewing the applications of electricty in agriculture. Illustrations showing the lighting, by modern methods, of a barn and a stable are included. The lighting is effected by lamps in enamelled reflectors mounted close to the ceiling. We do not think anyone could fail to be struck by the advantages of such conditions, as compared with the usual obscurity of farm buildings. Another picture illustrates the use of " artificial sunlight " to encourage the growth of chicks, and it is stated that by this means the percentage mortality is considerably reduced. An educational exhibition, illustrating the applications of electricity in agriculture, was recently organized under the auspices of the *Administration de la Foire de Lyon*. The exhibits, arranged by *La Compagnie du Gaz de Lyon* (*Gaz et Electricité*), comprised practical demonstrations of electric appliances on the farm. Such exhibitions should be made a feature of campaigns in connection with the schemes of rural electrification which will doubtless be developed in this country in the near future. It may be inexpedient to attempt too much in this direction until the electricity is available, but educational propaganda should not be delayed too long.

The Lighting Value of Paint

Discussions on " architectural lighting " have served to emphasize the intimate relation of schemes of decoration to lighting problems, and especially the part played by reflection of light from painted surfaces. From the standpoint of efficiency it is naturally desirable to obtain maximum reflection. But the most pleasing effects do not usually encourage the use of a dead white. A pure white ceiling is less attractive than one executed in cream, and even in offices some consider that it is not expedient to exceed a reflection factor of about 50 per cent. for walls. This fact is recalled by Mr. M. Luckiesh in a recent contribution to *The Electrical World*. He remarks that, contrary to the general belief, mat paints are just as efficient as glossy ones; they collect no more dirt (is this true in the smoke-laden atmosphere of London?), and are more desirable as diffusers of light. Lighting experts should do everything possible to encourage owners to have their walls and ceilings repainted at frequent intervals. A householder who takes a pride in doing this will probably also maintain lighting fittings in a cleanly condition. It is not difficult to show that the economic value of the loss in illumination through darkened walls and ceilings justifies repainting at fairly frequent intervals. Mr. Luckiesh makes a simple calculation to show that the economic period between paintings must be much less than 2,400 hours.

Illuminated House Numbers in Stockholm

We have from time to time quoted instances of enterprise on the part of Continental cities in connection with the lighting-up of house names and numbers, which in some cases has been made obligatory. The latest example brought to our notice is Stockholm, which, with characteristic enterprise, is endeavouring to make this a public duty. We give elsewhere in this issue an illustrated account of the exhibition, " Light in the Service of Mankind," recently held in that city. Readers will notice that illuminated house numbers form a feature of the model street exhibited.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Architectural Lighting

IN what follows we give an account of the discussion following Mr. Waldo Maitland's paper on "Architectural Lighting," which was read before the Illuminating Engineering Society on March 19th and was reproduced in our last issue.*

The PRESIDENT (Mr. C. C. Paterson), after complimenting Mr. Maitland on his paper, called upon Mr. H. T. Young to open the discussion.

Mr. H. T. YOUNG, congratulated the author on his interesting and practical paper. He recalled that about ten years ago Mr. J. B. Fagan, a theatrical producer, read a paper before the Society on the Lighting of Theatres, showing how he had put ideas into practice similar to those explained by Mr. Maitland. The old Court Theatre was a very early example of architectural lighting. He (Mr Young) could speak of this with practical experience, as he had had the pleasure of assisting Mr. Fagan. In Paris, in particular, the vogue had been established of associating art and electricity and had led artists, architects and designers all over the world to appreciate the possibilities of lighting. The paper was an epoch-making one for the Society and he had nothing but praise for it.

Cheaper electricity had made it possible in this country to have much more light, and one had not to think so much as previously about the amount of current consumed. Electrical engineers should consider the size of the rooms with which they were dealing and adjust the wattage accordingly. In architectural lighting exact calculation of intensities was not so necessary, and he thought that too much standardization should be avoided. It would be very easy from time to time to change the glass in front of the course of light. There were so many things of which we were unavoidably ignorant that he thought we ought not to attempt very fine calculations at present.

Glass had been used recently to a very large extent, but he thought that the metal work of the craftsman should not be forgotten by the artist. In his opinion metal could often be used with advantage provided one avoided dust-harbouring scrolls and the like. Lighting engineers should assist the architect and the designer to defeat the man who traded on ignorance and put in twice as much cable as was required, or twice as many lamps.

Professor HOWARD ROBERTSON (Principal, Architectural Association) stated that he was very much interested in the subject. One problem of the architect was to get sufficient light without using too much power. Modern lighting was apt to be difficult from the point of view of consumption and in many existing buildings one could not get the power that one would like. Panels and concealed lights, for example, frequently absorbed an enormous amount of light. Modern designers abroad apparently used electricity very freely. In England the fittings had to be such as to give good intensity of illumination in relation to the energy consumed.

He thought that modern lighting was in some cases apt to be depressing. There was something about a visible bright spot of light which had an enlivening effect on those using the room in which it was placed and those responsible should not be carried away by subdued effects. Probably the ideal method of illumination should represent both types. In some modern fittings the glass was too close to the bulb. In the case of one installation in Paris it had been stated that about 50 per cent. of the small lamps cracked when the door was opened on account of the draught, the lamps being very hot. A recent speaker at the R.I.B.A. had referred to the fact that the architectural effect of light in rooms was very different from that of ordinary daylight and that the mouldings and so on were designed for appearance by daylight, so that artificial light might give reverse shadows altering the whole effect.

Mr. OLIVER BERNARD remarked that he frequently received data laying down rules for the number of lamps that should be used and proposing more or less complex formulæ. He had also found difficulties in obtaining the particular varieties of glass or fittings he required and in getting lamp bulbs treated in a special way. People seemed disinclined to take the trouble to depart from standard methods and manufacture special articles. He himself believed that each lighting installation must be dealt with on its merits and that there was no general formula that could be successfully applied.

Mr. W. J. JONES thought that the paper would rank for many years as a classic on the subject. He had listened to it with very great pleasure and he knew what a great deal of thought had been given to its preparation. The author had succeeded in getting away from the track of familiar statements and had produced a logical thesis. It was essential that an architect like Mr. Maitland should give some guidance if they were to make progress, because engineers frequently had very little æsthetic sense. The methods indicated in the paper furnished a means of introducing intensity of illumination without even the semblance of glare. Ordinary methods of illumination were frequently limited by the brightness of the light source.

The author had raised the question of the permanence of these new methods of illumination. He thought that the present conception of architectural lighting was a rational one, but it might quite well be subject to modification and development in the near future.

Mr. P. J. WALDRAM congratulated the Council on the selection of the subject, and the author for his thoughtful and interesting paper. It was important that the lighting engineer, whether a consultant or sub-contractor or both (as was often the case), should realize his right position with regard to the architect. The lighting engineer was far too apt to regard himself as a specialist whose function it was to tell the architect what the archi-

* *The Illuminating Engineer*, April, 1929, pp. 89 to 96.

tect wanted and how to obtain it. The architect, on the other hand, regarded the lighting engineer merely as one of a small army of craft specialists whose efforts he had to co-ordinate, after the manner of an orchestral conductor, into one tuneful production. Therefore, although ready and willing to learn, the architect did not always relish being instructed by the lighting engineer, any more than the conductor liked the first violin or the leading trombone to show him how a given passage should be interpreted. When the lighting engineer realized that it was his duty to ascertain the effects desired by the architect and to strive loyally to obtain them, if necessary, within limits imposed by the work of fellow craftsmen no less important than himself, they might look forward to beautiful lighting effects which would give English lighting the same distinctive world-wide reputation as was enjoyed to-day by the best English architecture or the best English furniture. When one thought comprehensively of present lighting one could not escape the recollection of numerous examples of glare and vulgarity, obtrusive false unreality and bad taste in colour. Buildings noble and beautiful by day as the architect had left them were often most unpleasant by night because spoilt by the lighting. In many instances modern lighting was apt to be, not merely depressing, but infuriating. That was because, in the physical and physiological sensations which the memory recalled, glare, over-intrusiveness, ostentation, colour discords and other faults had fixed themselves on the attention to the exclusion of everything else, as in the case where the discord was remembered rather than the beautiful melody which it had ruined.

There was much to learn and throughout the paper one found reference to the truths which made up the sum of artistic righteousness. He wished that Mr. Maitland had further explored the basic architectural principles and had drawn attention to examples which offended against them. The author suggested that in many cases the lighting should be the major element in the architectural design. Truth and simplicity should always be before the mind of the architect.

The paper had quite rightly drawn attention to the over-illumination of structural features such as columns. He knew that the architect was very often supposed to be obsessed with ideas which were not practical, but, after all, the architect was the master craftsman, and, in designing buildings, mainly had regard to their appearance in daylight. That applied even to interiors. All that lighting could do was to simulate daylight effects. Many of the difficulties connected with artificial lighting would be overcome if they were referred back to daylight effects. The depressing effect of totally indirect lighting very largely disappeared when the action of the sun's rays was more perfectly imitated.

With regard to luminous windows it was not uninteresting to note that they were fairly largely employed in ship lighting, and they would be used to a larger extent in the future. They were first suggested, he thought, at the National Physical Laboratory by Dr. Walsh and had been a marked success.

In conclusion, he would recommend lighting engineers to study closely the architect's ideals, subordinating their work to his requirements, his aspirations, his annoying limitations and apparently stupid prejudices. After all, the architect was by far the best customer of the lighting engineer and it would pay to think as the architect thought.

Mr. A. W. BEUTTELL considered the paper an excellent one. It seemed to him that the E.L.M.A. Lighting Service Bureau could always be relied on to put its finger at the right time on the most important problems. There was no doubt that the question of architectural lighting was of growing importance and it had undoubtedly come to stay. In Continental cities, and in Paris in particular, the type of lighting which was the subject of the paper had acquired an impetus that would carry it very much further. In these matters the English were lagging behind the French, who had been pioneers to some extent.

The question of co-operation between the architect and the lighting engineer was a very important one, and he therefore hoped that it would occupy the attention of the Council very seriously in the future.

He had been very greatly interested by the remarks of the last speaker, for whose candour he was sure they were very much obliged. It was true that illuminating engineers felt that they were specialists and had much to teach architects, but as a matter of fact they had also much to learn from architects. He thought that the real reason for the lack of co-operation was that they did not properly understand each other. It was of no use to keep at a distance and try to reach across a river over which there was no bridge. How could a bridge be established? He thought that if illuminating engineers could read papers before such a body as the R.I.B.A., discussion following, a good deal of good would be done. It would give both parties an opportunity of speaking their minds on the essential points and would promote co-operation.

Mr. A. CUNNINGTON stated that he had been intrigued by the description of the marquise at the Galeries Lafayette in Paris. The consumption of current, which was very heavy, equalled the total supply of energy to such places as Epsom, Horsham and Windsor.

The lighting engineer's function was mainly in connection with practical details. In dealing with installations, provision had to be made for keeping the apparatus in perfect order when exposed to the outside air, as nature was always putting it out of order. Very large sums could be spent on securing decorative effects, and a scheme like the marquise was consuming money all the time for current and maintenance. This was a very serious consideration.

Reference had been made to current being freely used and to the inefficiency of some of the devices used. This, he thought, illustrated the need for co-operation. Getting together and talking things over on a friendly basis helped wonderfully in dealing with awkward points and lessened friction. The lighting engineer should at least be up to the standard of the first violin, credit being given to the architect for conducting the orchestra.

Mr. J. M. WALDRAM said that the author had given a useful survey of a new development in lighting and was to be congratulated. It was the business of the electrical engineer to be thoroughly familiar with every development in the art which he practised. The examples of buildings given in the paper were confined to a section where commercial attractiveness was of very high importance. Such work might or might not be in good taste. He did not know whether architects would agree that no one feature of an interior should call attention to itself or obtrude on the notice of an observer. Except where commercial attractiveness was of primary importance, possibly the highest compliment that one could pay to a system of lighting was to be unconscious of it. When he visited the Philadelphia Art Gallery he mistook the artificial lighting for daylight.

Mr. C. W. SULLY emphasized the importance of co-operation. Last year, when visiting the United States, he found in Chicago a Society which was working on lines very similar to those of the Electrical Development Association of this country, and had found a special committee to deal with the requirements of architects. An architect was engaged whose duty it was to keep in touch with other architects, inform the committee of their wants, ascertain from the committee the best way of supplying them and then give an introduction to the right quarter. He believed that such an arrangement would be very helpful in this country, and he hoped that some day it would be established here. The E.L.M.A Bureau had recently been asked by a body representing architects to supply an exhibit indicating the different possibilities of lighting, and he hoped that compliance with the request would lead to the development of something of the sort that he had referred to.

Mr. WALKER thought that if the various forms of fittings could be standardized and sold cheaply they would be readily taken up.

Mr. H. E. DOWLING, speaking as a decorator and

decorative adviser, said that he probably regarded the question from an entirely different point of view from that of most of the others present. His enquiries had shown him that there was considerable difficulty in inducing glass merchants in this country to take up the requirements of architectural lighting. Unless these requirements were dealt with in a competent way resort would have to be had to manufacturers in foreign countries. He would suggest that those members who had the time should go to Dusseldorf and Stuttgart to study the conditions there. France was receiving the chief credit for this lighting revolution, but much ingenious work was being done in Germany. A tour of the cinemas and restaurants there would show how much we could learn in regard to these special methods of lighting.

Mr. WALDO MAITLAND, in reply:—

Mr. H. T. Young, in his remarks, mentioned that in architectural lighting the exact calculation of illumination intensities was not so necessary as in other fields of lighting. In this I agree with him up to a certain point, for, in my opinion, exact calculations as to intensity are not the primary consideration in architectural lighting, effect and atmosphere being its chief function. But, at the same time, there are many instances where architectural lighting forms the illuminating element, in which case accuracy as to intensity is essential, and possible provided that the absorption and distribution properties of the translucent material are known.

Professor H. Robertson mentioned that the lamps are frequently placed too close to the glass, resulting in the failure of the lamps. This fault is, of course, to be found in many modern fittings and arises from lack of knowledge of the technical requirements of glass and the properties of electric lamps. Further, the designer often gives little thought to the final effect of the fittings, with the result, in most cases, that there are ugly spots of light which do not bear any relationship to the design on the glass. The designer should therefore study the fitting in terms of effect, placing lamps of suitable wattage and size in the correct position. He should also consider very carefully the constructional details. Wiring should be made easy, and walls should be protected from the heat produced by the lamp. The latter may be effected by placing a thin asbestos sheet behind the back plate.

Mr. W. J. Jones remarked that doubtless modification and development would take place in the future. Up to the present architectural lighting has been applied to buildings with a view to developing something new, the character of which is in sympathy with modern architecture. Present examples are a trifle crude, but all movements in the progress of Art are necessarily primitive until a better understanding is established, and in a few years beautiful examples of architectural lighting will no doubt be seen.

In referring to the paper, Mr. P. J. Waldram remarked that lighting should not become the major element in the planning of buildings. Light, however, as we know, is the major element of the universe; without light we cannot see and we cannot appreciate form.

With regard to artificial light, the imaginative artist welcomes this new element but has no desire to imitate daylight, which he knows is beyond his power. Therefore he treats artificial light in a different way, and, since he is able to place it in any position, he can create certain effects which are not possible with natural daylight. By this means he is able to impart character to the atmosphere of the interior.

In architectural designs the artist is always endeavouring to express some main feature in his composition: some dominant force which rules all other units in the building.

In one of Sir John Soane's* lectures on "Architecture" he well emphasizes the importance of the dominant when describing the portico of St. Mary-in-the-Strand, by James Gibbs:—

> "The small portico of this church, however beautiful in itself, is disproportioned to the rest of the building and unmeaningly placed. There is no principal feature to arrest the attention of the spectator, which is as necessary in the building as in any other composition. In every poem we seek for a distinguishing and chief object; in every picture a principal figure or group, a principal colour, a principal light, to which every other must be subservient: from these, as so many radii, the other parts diverge."

Mr. Waldram went on to say that the depressing effect of total indirect lighting disappeared when the action of the sun's rays is more perfectly imitated. The depression of totally indirect light is well known, and successful interior lighting problems have always been supplemented by direct-lighting units, but any serious attempt to imitate the sun's rays as a means of interior lighting seems to me an ambitious proposition.

* The Architectural Association *Journal*, March, 1929, "Lectures on Architecture," by Sir John Soane, R.A.

Errors in Testing Bulk Supply by Random Selection

Some interesting points were raised in a paper on the above subject recently read by Mr. B. P. Dudding before the Institution of Engineering Inspection.

The engineer has often to determine average quality by the inspection of samples selected at random. Rough justice is usually attained by this procedure, but occasionally such tests show odd variations. The author accordingly discusses the Gaussian Law and the "method of least squares" by which the probable error in a series of observations can be determined. The operation of the process is considered in relation to two varieties of test, on (*a*) the average strength of glass tubing and (*b*) the average life of incandescent lamps.

The latter series of tests is of special interest. Long usage has established an average life slightly in excess of 1,000 hours as satisfactory for most purposes, and this figure is adopted as the basis for the B.E.S.A. Specification. There are, however, reasons for expecting some departure from the Gaussian Law. There are many factors which contribute to small changes in life. Such causes are often in themselves extremely small and below the low limit measurable by chemical or physical methods —in fact the life of the hot filament is for many of these variants the most sensitive test known!

Amongst such causes may be mentioned:—

1. Variations in amount and distribution of volatile impurities (known to be less than 0.03 per cent.).
2. Small variations in filament diameter (less than ½ per cent.).
3. Variations in degree of vacuum or purity of gas. The slight variations concerned are due to gases evolved by metal and/or glass parts.
4. Variations in surface defects on filament, which may affect its electrical resistance or emissivity.
5. Variations in filament length and diameter leading to variations in the operating temperature of filaments.
6. Minute mechanical defects enhanced and developed at different rates by the continual reversal of stress due to the heating and cooling of the lamp in service.
7. Variations in conditions of test.

Data on life performance are conveniently illustrated by "survivor curves," which bear a close relation to the size of filament. In the original paper two typical survivor curves, one B associated only with the smallest filaments, are shown. The analysis of these curves yields interesting results. Thus for curve B lamps as many as 176 lamps must be tested in order that there is only one chance in ten that the error in life determination will exceed 50 hours. Generally speaking, the figures show that for lamps made under good conditions, whose average life lies between 1,000 and 1,500 hours, there is about one chance in ten that the average life of ten selected at random will be in error by as much as 200 hours and 300 hours for lamps conforming to the survivor curves A and B respectively.

A Study of the Current Practice of the Lighting of School Buildings in the United States

By JAMES E. IVES, Physicist, United States Public Health Service

THIS article presents a review of the current practice of the lighting of school buildings in the United States which was prepared at the request of the committee on lighting legislation of the Illuminating Engineering Society. An enquiry was addressed to the departments of education of the 48 States, and of 12 of the principal cities. Answers were received from 39 of the States and 9 of the cities.

The information supplied in answer to the letters came in the form of lighting rules and codes, building codes, and information contained in letters. This information has been summarized under the following heads:—

Colour of walls.
Colour of ceiling.
Finish and colour of woodwork.
Unilateral or other lighting by windows.
Preferred exposure of windows.
Dimensions of class-rooms.
Ratio of window area to floor area.
Type and location of windows:
  Height of sill.
  Height of ceiling.
Character of shades.
Artificial lighting:
  Intensity of illumination on desks, recommended or required.
  Watts per square foot.
  Control of lights by switches.
  Exit and emergency lighting.
Inspection and maintenance.
Glare.

The information obtained was as follows:—

Colour of walls and ceilings.—Sixteen recommend a choice between one or more of the following colours: Light buff, light grey, light yellow, or light green, the preference usually being in the order given. Three recommend brown for the dado, or wainscoting, and one, French grey. A dull finish is recommended in three cases, and in four cases it is specifically recommended that the walls shall not be white. In one case a finish is required having an initial coefficient of reflection of from 0.25 to 0.50.

Colour of ceiling.—Fifteen recommend a choice between one or more of the following colours: Cream, ivory white, or white, the preference usually being in the order given. Four recommend that the ceiling shall be of the same colour as the walls, but of a lighter shade. Two recommend flat paint; one a neutral colour, and one specifies that the colour shall not be white—one requires that the ceilings be finished with a matte or semimatte service having an initial coefficient of reflection of at least 0.70.

Finish and colour of woodwork.—Only five refer to the finish and colour of the woodwork. The individual specifications are as follows: Eggshell gloss, dull finish, same colour as walls, natural colour with a dull surface; and usually light oak in new schools.

Unilateral or other lighting by windows.—Thirty-one specify unilateral lighting. Fourteen of these permit also windows in the rear. In some cases it is specified that windows in the rear must be at least 6 ft. above the floor, and in one case it is specified that no more than 50 per cent. of the light shall come from the rear. One states that the windows shall be on the long side only. Other individual cases are as follows: If the room is more than 23 ft. wide high windows on right-hand side may be used, at least 6 ft. from the floor. Small windows on other sides than the left, placed high, are permissible. High windows on the right side are permissible if they are at least 7 ft. above the floor. Unilateral, except when the room is more than 24 ft. wide. No skylights unless they are constructed to exclude direct sunlight and excessively bright light from the sky.

Preferred exposure.—Ten of the States recommend or require that the windows should have certain exposures. In five cases an east or west exposure for the windows is preferred. In one case it is required. In another case east is preferred, and west is given as second choice. The three other cases are: East or north; east, north-east, north-west, or west; north or south-east; and east or south-east.

Dimensions of classrooms.—Twenty of the States and cities have requirements as to the length, breadth, and height of classrooms. There is some agreement as to the height of the ceiling, nine of them specifying that it shall not be less than 12 feet. In four cases a width of room of 23 ft. is specified. Usually the width and length are specified in combination with each other and sometimes the ratio of length to width is given.

Ratio of window area to floor area.—The least permissible ratio of window area to floor area is specified in 32 cases. In 1 case it is specified that the ratio shall not be less than 1 to 4; in 21 cases not less than 1 to 5; in 6 cases not less than 1 to 6; and in 1 case not less than 1 to 7. In 1 case it is specified that in general the ratio must not be less than 1 to 5, but when the light is from the north the ratio must be not less than 1 to 4. In another case it is specified that it must not be less than 1 to 5 if the windows are on the left only, and not less than 1 to 4 if the windows are on the left and rear.

Height of window sill from the floor. This is specified in 19 cases. The least permissible height varies in individual cases from 2 ft. 6 ins. to 4 ft. In 3 cases a height of 4 ft. is specified, in 2 cases 3 ft. 6 ins., and in 2 cases 4 ft. In 1 case a height of not less than 2 ft. 6 ins. is specified, but 3 ft. to 3 ft. 6 ins. is recommended for grades above the fourth. In another case, not less than 3 ft. 2 ins. nor more than 3 ft. 6 ins., except in special cases, is specified. In other cases values are given as the least values permissible.

Distance from top of window to ceiling.—This distance is mentioned in 21 cases and varies from "a distance as near to the ceiling as possible," to "a distance of 18 ins. for a ceiling 14 ft. high." In 5 cases it is stated that it should not be more than 6 ins.; in 4 cases not more than 1 in. In one case the least distance is made to depend upon the height of the ceiling, 1 in. if the ceiling is from 11 to 12 ft. high, and 18 ins. if the ceiling is from 13 to 14 ft. high. In 1 case it is specified that window heads shall not be less than 11 ft. 4 ins. above the floor, and that there shall be less than 12 ins. from the top of the glass to the ceiling.

Character of window shades.—The character of the window shades is specified in 17 cases—translucent shades are specified in 12 cases. Double rollers are specified in 5 cases. The colours recommended are very variable, white, ecru, blue, grey, slate, buff, tan, champagne, neutral, cream, straw, etc. In 2 cases it is stated that the shade should be adjustable both from the top and bottom of the window. In 2 cases a choice is given between two shades adjustable at middle of the window, or a single roller with patent adjustable fixtures. In 1 case a translucent shade which rolls from the top down and a heavy dark shade (green) which rolls from the bottom up, is recommended. In 1 case it is stated that the colour of the shades must harmonize with the colour of the walls.

Intensity of artificial illumination on desks.—In only 7 cases is the least permissible intensity of the illumination on the desks specified. The values given range from 3 to 8 foot-candles, the individual values being 3, 3·41, 4·7, 5, 6, and 5 required and 8 recommended.

*Abstract of Public Health Report No. 1261; issued by the United States Public Health Service, Washington.

Least watts per square foot of floor area.—This quantity is specified in only 4 cases, the values given being 0.9, 1.1 to 1.3, 1.25, and about 1.74.

Control of light by switches.—This is specified in 4 cases, as follows: Switches should be at points of entrance. Switching and controlling apparatus should be installed at entrance to classrooms, hallways, etc.—one switch for lights next to corridor and one for lights next to windows. Switching or controlling apparatus should be so arranged at entrance to each room that a portion of the lights of the room may be turned on.

Exit and emergency lighting.—This is specified in 4 cases, as follows: Corridors, stairways, and egresses shall be suitably lighted and there shall be a suitable number of emergency lights. Emergency lights should be placed at main stairways and exits. Exit lights should be used for halls and gymnasiums. Electric emergency lighting should be supplied from an independent connection extending back to main service entrance, and in every building used at night a red light shall be placed over every emergency exit door, and over every exit door where other doors may cause confusion.

Inspection and maintenance.—There were only three references under this head, viz.: Walls must be kept clean. All parts of lighting system should be frequently inspected and properly maintained. All parts of system should be frequently inspected and defective parts replaced or repaired. Windows should be frequently washed, walls and ceilings washed or redecorated periodically.

Glare.—Provisions against glare occur in 18 cases. They deal with the character and position of blackboards, the nature and position of lighting units, and the distance from the front wall of the room to the first window. The most important provisions specified are:—

1. Blackboards shall be non-reflecting.

2. Blackboards shall be placed in front (behind the teacher's desk) and upon walls on the right-hand side of the classroom.

3. Lights should be shaded and placed well out of the ordinary range of vision.

4. There should be a distance of from 4 to 8 ft. from the front wall of the room to the first window on the left-hand side of the classroom.

This last important specification is made in 9 cases. In 1 case it is stated that it is desirable artificial lighting should have the same general direction as natural lighting; that is, from the left and slightly from the rear.

It will be noted that there is a great divergence among the different States and cities of the Union as to their requirements for natural and artificial lighting of schoolrooms. It is evident that these requirements should be standardized as far as possible. Most of these requirements are discussed in the American Standard Code of Lighting School Buildings, prepared and issued by the Illuminating Engineering Society and the American Institute of Architects in 1924, and the requirements of this code might logically be made the requirements of the individual States and cities. Since most of the schools in the United States have no provision for artificial lighting and are only occupied in the daytime, provisions for the proper day lighting of schools are more important at the present time than those for artificial lighting. However, as schools become used more and more in the evening for instructional and social purposes, the artificial lighting of schools will become more and more important.

[The above data should be of considerable interest to those concerned with the lighting of schoolrooms in this country. The time is ripe for the issue of recommendations on this subject. Little has been done since the issue of the report of the Joint Committee of the Illuminating Engineering Society, which reported shortly before the war, though some suggested modifications in this report were put forward in a paper read before the Society by Dr. James Kerr in 1926.]

Modern Hospital Lighting

IN our last issue we referred to several interesting installations in hospitals in the United States, described by Kirk M. Reid in a recent issue of *Light*. By the courtesy of the Editor of *Light* we are now enabled to reproduce several of these pictures. The first of these (Fig. 1) illustrates the arrangement adopted in the operating room of the Cleveland Clinic. Macbeth "daylight" units are mounted in recesses in the ceiling, and this series of units is considered quite effective in eliminating troublesome shadows. Generally speaking, highly diffused lighting is desirable for shadow prevention. Nevertheless, in order to obtain the requisite high illumination on the table with reasonable economy, some degree of concentration is necessary, the rest of the room being lighted to a lower degree. For diagnosis and for minor operations portable stand lamps are occasionally useful, and it is expedient that every operating room should be provided with an emergency hand lamp supplied from storage batteries, so as to guard against the possibility (fortunately now remote) of a failure of the electricity supply.

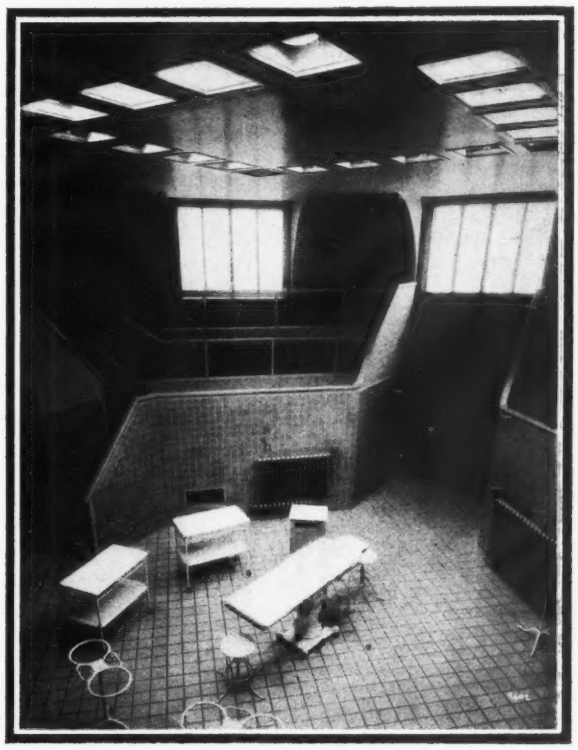


FIG. 1.—The Operating Room, Cleveland Clinic, U.S.A., showing artificial daylight units recessed in ceiling.

Fig. 2 shows the use of indirect lighting in a ward at the Sibley Hospital, Washington. This method of lighting has much to recommend it, as lamps are entirely screened from view. At the same time the author suggests that supplementary local lighting from the head of the bed should be provided for reading and writing. Such additional lighting also aids the examinations and ministrations of doctors and nurses.

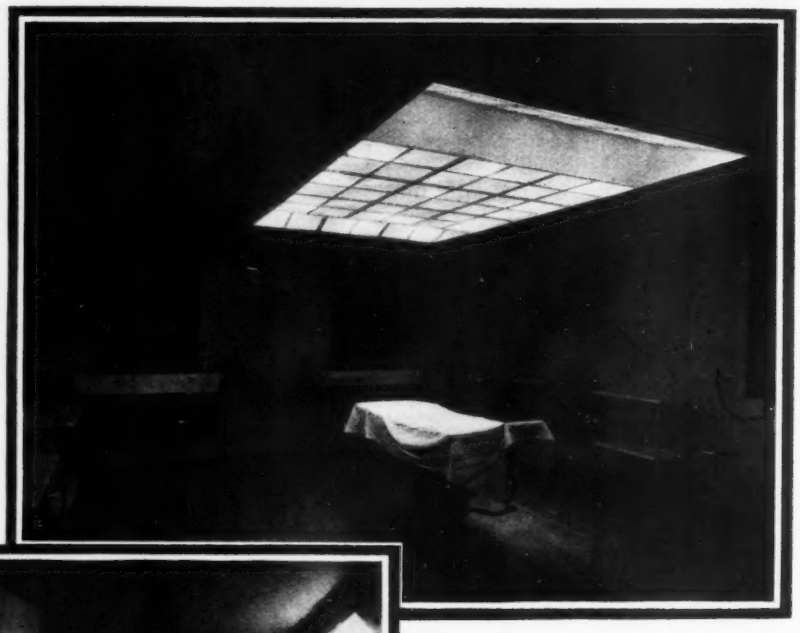
In the remaining illustrations we have two more examples of modern methods of lighting operating rooms. In Fig. 3 is shown a view of a major operating room equipped with concentrating units, mounted above an artificial skylight. In Fig. 4 we have a minor operating room, where light is furnished by four focussing units mounted in boxes.

The lighting of operating rooms furnishes one example of the special advantages associated with the use of artificial light. In some modern hospitals window-space is restricted to a minimum, only space sufficient for ventilation and to facilitate cleaning of the room being provided. For operating purposes reliance is placed

FIG. 2.—Showing Indirect Lighting in a Ward in Sibley Hospital, Washington.

almost entirely on the artificial lighting. The diminution in window space is economical in first cost, and has the further advantage of increasing the space available for observation by students.

The degree of artificial illumination used in some modern operating theatres, which may attain hundreds of foot-candles, is probably fully justified by the exacting requirements. Obviously good lighting is one of the most vital things for the successful carrying out of operations. It is estimated, however, that the running cost of the lighting is only about equal to that expended on gauze and bandages and thus forms an insignificant proportion of the total expenses.



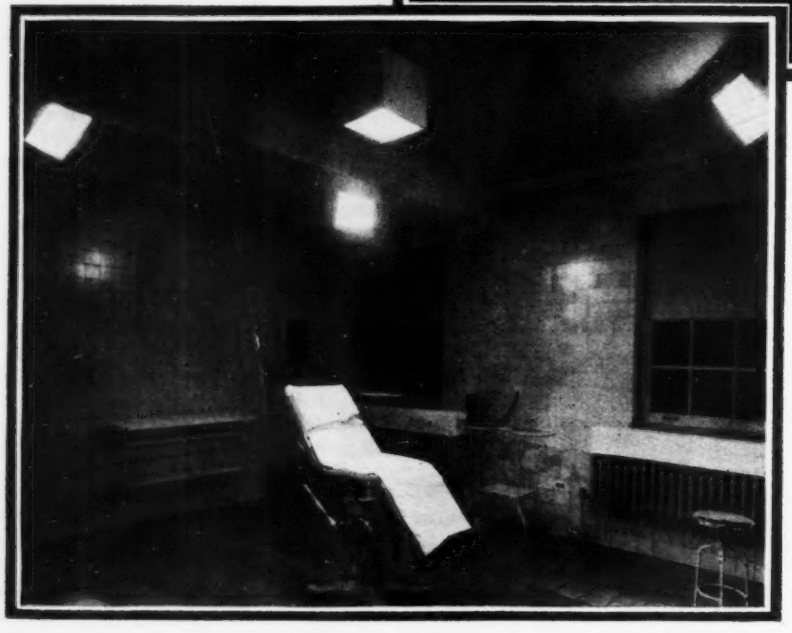


FIG. 3 (*above*).—An Operating Room with concentrated lighting; and

FIG. 4 (*left*).—A Minor Operating Room with four focussed units.

In this note reference has been made only to two of the main problems in hospital lighting, i.e., the lighting of operating theatres and wards. It should be realized, however, that these are only two out of many problems, and that the direct application of luminous radiation for the treatment of disease is in itself a very wide subject.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

Lighting at the Ideal Home Exhibition

(Contributed by the E.L.M.A. Lighting Service Bureau.)

AN exhibition presents exceptional possibilities from a lighting point of view, for, being of a temporary nature, lighting features which would be looked upon as extravagant for continuous service are willingly installed by exhibitors when only a few weeks' running cost is to be borne.

The use of electric lighting in exhibitions is associated with the earliest days of the electric lamp industry, since the public came to know and appreciate electric lighting mainly by demonstrations at the great exhibitions of the latter years of the nineteenth century. It was not, however, until the British Empire Exhibition in 1924 that any remarkable progress was made in spectacular artificial lighting for this purpose—at any rate as far as this country was concerned. Wembley, however, saw the introduction of some unique lighting treatments, and in many ways the great exhibition constituted a turning point in the previously somewhat haphazard application of lighting in this field.

Exhibition organizers are now beginning to appreciate that artificial lighting exerts an enormous effect for good or evil upon the general tone and appeal of the exhibition, and consequently it is not surprising to find that, in Ideal Home Exhibition, lighting has been featured to a greater extent every year.

This exhibition held annually at Olympia is probably the most popular event of its kind in the country. It deals with the subject which is necessarily of interest to almost every member of the community, and is backed by the highly efficient publicity force of a large national newspaper. It is not surprising, therefore, to find that attendance records are broken year after year.

The electrical industry is usually well represented at the exhibition by the extensive stands of lamp and fittings manufacturers, and each year these firms make a vigorous effort to ensure that public interest is maintained by some new method of arrangement, while, in addition, the improvements which have been effected in the rapidly growing lighting industry are incorporated in the stands and in the displays.

Apart from these stands, however, there are many displays incorporating model or specimen rooms, indicating examples of furnishing systems of wall covering, floor covering, etc., and in these electric lighting has necessarily to play an important part. It was very apparent that this year nearly all these displays were vastly improved from a lighting point of view. It seemed, indeed, that at one bound the potentialities of electric lighting as a furnishing and advertising medium had been completely grasped by the exhibitors. Much of the lighting was of the modern architectural type to conform with the character of the interiors which were treated in a modern style, while many instances were noticeable where floodlighting was inconspicuously introduced to emphasize particular display areas.

FIG. 1.—Lighting of Gardens at the Ideal Home Exhibition.

The visitor touring the exhibition was confronted by almost every electric lighting device at present marketed, and it was noticeable that particular use was made of the many ingenious forms of electric signs and message-spelling devices which have been evolved in the last few years.

It was not, however, this general adoption of modern electric lighting which created the greatest impression when comparing this year's exhibition with last; it was rather the excellent co-ordination between the different sections which had been effected by the pleasing and orderly arrangements of the stands. A truly remarkable continuity was maintained from one stand to the other by luminous cornices, while the impressive centre section, surmounted by the wonderfully effective luminous fountain, gave the whole exhibition a unique appearance, very dissimilar from that of the average miscellaneous effect to which we have been accustomed in the past.

It would be possible to enlarge almost indefinitely upon the excellent co-ordination between the architect and lighting engineer which has so evidently been established on this occasion, since one so rarely sees the happy results of this powerful partnership, but no visitors to the exhibition can have failed to appreciate this great improvement, which even the most dense of crowds could not despoil.

For many years the gardens have constituted a prominent feature of the exhibition, and represent to the somewhat weary visitor a haven of rest and quietness from the busy atmosphere of the main hall. This year, again, they were laid out with the consummate skill of the landscape artist, and the lighting both by day and by night left little to be desired. The use of artificial

daylight was not attempted this year. This was presumably due to the fact that unless an enormous expenditure of energy can be met even a reasonable intensity of artificial daylight will produce an atmosphere which more nearly resembles twilight than daylight, owing to the very high order of intensities ordinarily experienced with daylight.

It is the opinion of the writer that the Ideal Home Exhibition this year has set a standard for exhibition lighting by which all future exhibitions of this nature may be judged, and we can confidently look forward to a still greater and more skilful application of artificial lighting even in smaller exhibitions, where the possibilities are, if anything, greater and the expenditure involved necessarily very much less.

Neon Lights and Fog-Penetrating Power

Some instructive tests have been carried out lately by Dr. Lyamn J. Briggs, of the Bureau of Standards (U.S.A), on the alleged fog-penetrating power of neon lights. The neon beacons adopted for aviation are said to have shown excellent results as regards visibility, especiaaly in misty weather. But some doubt seems to exist as to whether this is due to the colour of the light or to the fact of its being spread over an extensive area. In the tests conducted by the Bureau of Standards neon lamps were compared with incandescent lamps, so arranged that the colour, size and shape of the respective units were exactly the same. In these circumstances no real difference in fog-penetrating power could be detected.

A further experiment was made with incandescent lamps, one unscreened and one covered by a red screen. It was invariably found that the uncovered light could be seen through a greater thickness of fog. Merely putting a red glass in front of a white light, therefore, does not increase its penetrating power. But it will be observed that the interposing of a red glass cuts off some of the original light. Assuming two lights of equal size and brilliancy, one red and the other white, what would the result be?

There is, moreover, the further consideration whether a given volume of red light is not obtained more economically from a neon lamp than in the case of an incandescent lamp screened by red glass. One would be inclined to assume that, for a given candle-power, the energy required by the neon light would be considerably less.

A Conference on Street Noises

The Conference on Street Noises, called on the invitation of the Ministry of Transport recently, was a striking recognition of the fact that the noise of traffic in the London streets has become a well-nigh insupportable nuisance. It is curious to read in Col. R. E. Crompton's reminiscences that when he travelled from Thirsk to London in 1851 to view the Great Exhibition one of the things that impressed him most was the "extraordinary thunderous noise of the streets of London." At that time the streets must have been peaceful in comparison with the pandemonium of to-day. One would think that the two main lines of possible improvement to-day would be the choice of a more resilient road surface, such as rubber, and improved mechanical design of motor buses, lorries and the like; much of the clamour made by the latter is surely not inevitable. The noise of motor horns, on which the discussion seems to have been mainly concentrated, appears at first sight to be more easily susceptible of diminution. No doubt much of this noise is excessive; but when one attempts to frame regulations one is at once struck by the difficulties of definition. One recalls the confusion that arose during the Great War in connection with the attempts of the authorities to limit the use of light in the streets. To-day light is at least capable of meaurement with a fair degree of accuracy. The same cannot be said of sound, for which there is no recognized standard of intensity.

Street Lighting in Leicester

The annual report of the public lighting superintendent of the city of Leicester (Mr. Thomas Wilkie), which deals both with gas and electric lighting, usually contains information of interest. A feature of the report for 1928 is the continued progress in electric lighting. From September 30th the electric lighting has been taken over completely by the public lighting superintendent, and for the first time a number of new schemes have been handled by him, apparently with complete success. A number of important streets have been electrified and additional lamps have been erected on housing estates. In all 170 units (fifty-five 500-watt lamps and one hundred-and-fifteen 300-watt lamps) have been provided. 1,283 lamps have been renewed. A new electrical section with a separate workshop has been created. The number of electric lamps in use is now 830, as compared with 517 in 1927, and only 252 in 1925. The total candle-power has increased from 743,425 in 1925 to 888,783 in 1928.

The number of gas lamps is substantially the same as in 1927, but the price of gas has been materially diminished during the last few years, and the average candle-power per cubic ft. of gas consumed has shown a steady improvement, being now 28.10, as compared with 21.22 in 1925. Gradual replacement of obsolete lanterns is still being continued, though since February, 1925, 1,490 have already been so treated There is therefore a prospect of a still further improvement in average efficiency.

The Welfare Club has had a most successful year, and the loss of time through sickness has been very small—only 560 days off in 1928, as compared with 1,216 in 1926, being reported. A literary section has been formed for the purpose of attending lectures on lighting and allied subjects.

The cost of public lighting shows some increase, being 5.35d. per £, as compared with 4.87d. in 1925, but this is doubtless an inevitable result of new work done on housing estates. The present cost is equivalent to 2s. 6.14d. per head of population per annum: 1s. 11d. per linear yard of street per annum; and 1-20d. per linear yard per night.

The Cost of Natural Lighting

It is reported that the Louvre in Paris is at length to be provided with electric light. The installation will cost about two million francs, but even so it appears to be a desirable measure in view of the advantage of enabling the building to be visited in the evenings. Incidentally it is pointed out that the Louvre furnishes a striking disproof of the conception that "daylight costs nothing," for the cleaning of its immense windows has long been a matter for concern to the authorities. Apparently it is a full day's work for a man to clean a single one of them!

This example recalls to mind an instructive analysis of the cost of lighting industrial builings recently contributed by Mr. E. L. Holladay to the *Journal of the Franklin Institute*. The analysis is somewhat complex, but a number of interesting conclusions emerge. Thus it is usually economical to equip industrial buildings with simple side-windows for natural lighting, though strictly speaking the economical limit is reached when electricity costs more than about ¾d. per unit. Sawtooth windows are only justified when electricity costs more than 2.2 cents (say 1d.) per unit. It is rarely economical to have a light court surrounding a six-story building of a greater width than the building height.

These conclusions hold good for American practice, but no doubt similar figures might be derived for city areas in this country. The calculation, however, seems to leave out of consideration the desirability of entrance of daylight on purely hygienic grounds. We rather question whether authorities would approve any building from which daylight was entirely excluded, however good the case for artificial lighting might be from the economic standpoint.

Light in the Service of Mankind

An Interesting Exhibition in Stockholm

BY the kindness of one of our correspondents, Mr. Torsten Holmgren, of Stockholm, we have received some further particulars of the enterprising exhibition entitled "Light in the Service of Mankind," held in that city during September 1st–23rd, 1928. We are also indebted to the Svenska Foreningen for Ljuskultur for the loan of the illustrations accompanying this note, which are reproduced from photographs taken by the Berghne Studio in Stockholm, at the request of the Exhibition Committee.

This exhibition, which was held in the Liljevalchs Art Gallery, was organized jointly by the Royal Academy for Scientific and Engineering Research and the Swedish Electric Light Association. It aroused great public interest, and was the subject of much comment in the press, and special pains were taken to render the numerous exhibits a fitting illustration of the possibilities of artificial light. A full account of the exhibition is included in an illustrated booklet issued by the Svenska Foreningen for Ljuskultur, in which the accompanying illustrations and others appeared.

The exhibits included (1) a display of ancient lamps, etc., illustrating the historical development of methods of artificial lighting, (2) a special series of exhibits from the collections of the Technical Museum, and (3) a series of exhibits illustrating modern methods of lighting and lighting technicalities.

The special exhibits may be roughly classified as follows:—

I General Section:—
- (*a*) Principles of correct lighting.
- (*b*) Modern lighting fixtures.

II Educational Section:—
- (*c*) Lighting in the home.
- (*d*) Lighting of shop windows, and the use of illumination for a publicity and traffic control.
- (*e*) Factory lighting.
- (*f*) Light in relation to life generally.
- (*g*) Special applications of light.
- (*h*) Artificial daylight.

FIG. 1.—Illustrating Historical Development of Illuminants. (Exhibit from the Collection in the Technical Museum.)

The selected illustrations accompanying this note are but a few out of the numerous illustrations, 27 in number, in the illustrated booklet descriptive of the exhibition. They will, however, serve to give a general idea of the manner in which displays were arranged. In Fig. 1 we have a view of a part of the comprehensive historical exhibit, whilst Fig. 2 illustrates various applications of light for signalling and traffic control. On the left may be seen several examples of lighthouse equipment and beacons, on the right several traffic signs, including the familiar triangle.

In Fig. 3 we have an interesting exhibit showing the use of artificial daylight, and it is instructive to observe that the designers have not been content to imitate the colour of daylight, but, by arranging an artificial window, have aimed at reproducing the same general effect as is obtained by natural light. The window, however, is supplemented by several pendant units. In Fig. 4 various forms of "architectural lighting" are seen. We have the lighting-up of the diffusing dome by lamps concealed round the cornice, and on the walls there are examples of the use of combinations of rectangular diffusing units of the type now becoming familiar in England. On the walls there are also stencilled several quaint sketches, evidently conveying lessons in the principles of good lighting.

FIG. 2.—Exhibit illustrating the Use of Light for Signalling Purposes and Traffic Control.

The two final illustrations (Figs. 5 and 6) show an actual model of sections of a street, the Vinkelgatan (literally "angle-way"), showing centrally suspended street-lighting units, illuminated show windows and luminous signs and house numbers—the latter a development that is being actively taken up abroad.

In the full description before us many other exhibits are mentioned. There were, for example, demonstrations of elementary principles, such as the effect of varying intensity, glare and shadows, and the influence of colours of walls on the available illumination. These exhibits evidently resembled those arranged in the Home Office Industrial Museum in this country. Modern incandescent lamps in various types and sizes were on view, and a film performance illustrating the manufacture of incandescent lamps was given.

The lighting of schools and factories was illustrated by exhibits contrasting

good and bad methods. Thus a classroom was shown with badly arranged lighting units, leaving part of the walls in darkness and only imperfectly illuminating blackboard and maps; this was compared with a similar room lighted by modern semi-indirect methods, attention being drawn to the absence of glare and good distribution of light on desks, blackboard, etc. Similarly a workroom was shown with glaring individual lamps arranged over each machine, the lower parts of the machines and the floor being in semi-darkness; the same room was also shown with good uniform general lighting, with supplementary local lighting for special work. Offices, shop windows and various sections of the home were treated in a similar manner.

This exhibition, therefore, was evidently an exceptionally comprehensive one, and one would like to see a similar effort in this country. Here there are, from time to time, good examples of educational exhibits illustrating special points (e.g., industrial or shop lighting, etc.).

One should also not forget the unprecedented demonstration of street-lighting methods arranged by the Association of Public Lighting Engineers in Sheffield last year. In the Home Office Industrial Museum we have again some useful permanent exhibits of a simple kind, and at the E.L.M.A. Lighting Service Bureau constantly changing demonstrations are effectively staged. In neither case, however, is there space available for a really comprehensive exhibit not only bringing home fundamental principles but also illustrating, at one and the same time, all the main applications of lighting in the service of mankind. It would, perhaps, be impracticable at present to arrange for a permanent collection on this case, but occasional displays on special occasions, in which the whole lighting industry should participate, would probably make a strong appeal to the public now, when interest in lighting problems is so much keener and more widespread than in the past.

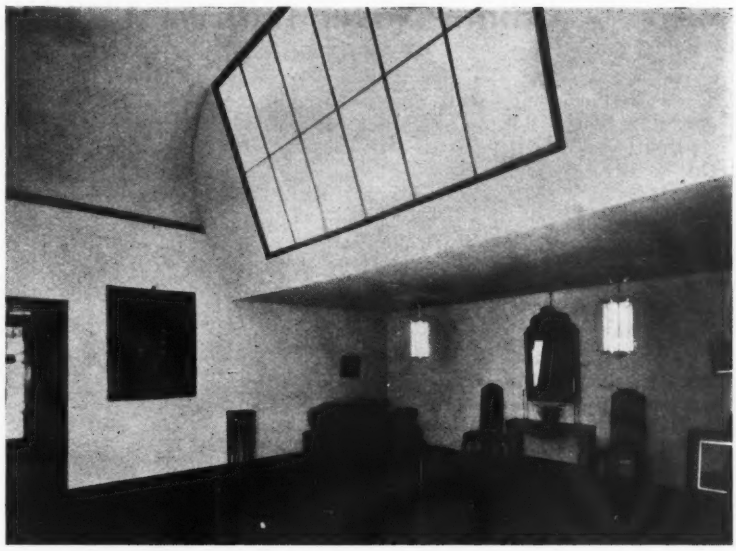


FIG. 3.—The Use of Artificial Daylight in a Studio. Daylight units, equipped with enamelled reflectors, furnish light to the artificial window.

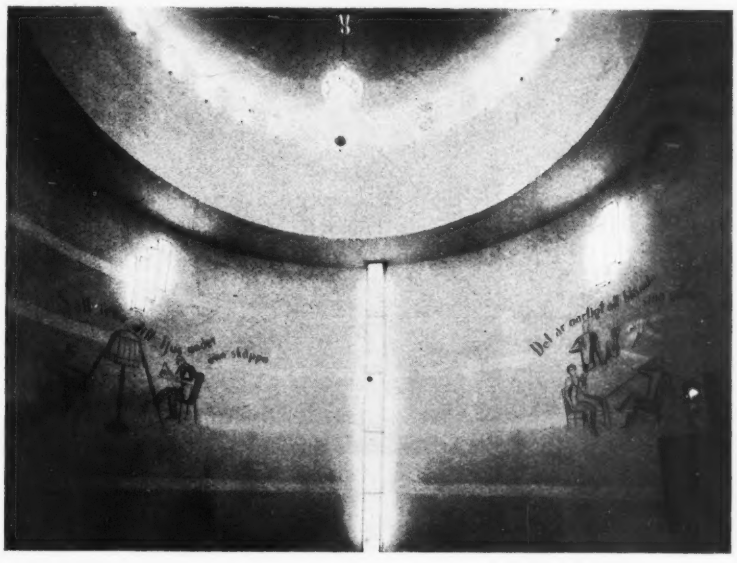


FIG. 4.—Architectural Lighting. Various luminous devices are incorporated in the structure of the room.

FIG. 5.—An actual model of a Street (the "Vinkelgatan"), showing illuminated house numbers and show windows.

FIG. 6.—Another section of the same model Street, showing centrally suspended fitting and illuminated signs.

Some Novel Indirect Lighting Installations

By G. F. ALLOM

IT was recently suggested that an account of some novel indirect lighting installations, based on the system which is associated with the writer's name, might be of interest to readers of *The Illuminating Engineer*. A few typical examples of such installations are here illustrated. It will be observed that the four installations utilize four quite distinct modes of applying the light, though in each case the lighting is indirect. All, however, depend upon the system evolved by the author, the chief feature of which is the use of high power beams of light, which are accurately projected and controlled.

Much naturally depends on the manner in which the light is directed. The beam is not that of a searchlight, with rays diverging at a very small angle, but is a flat fan-shaped beam produced by a reflector built up of a number of sections of mirrored glass, the width, curvature and size of which are regulated according to the requirements of the problem. In this manner the most varied and difficult lighting problems may be solved. This article deals with indirect lighting, but naturally the system can be applied in many different ways.

In connection with indirect lighting it has proved exceptionally economical. It is possible to obtain more even distribution of light over the walls and ceiling than is usual with some other methods; for example, when lighting is effected by means of lamps over a cornice, the cove or ceiling above appears to be lighted to a very high intensity in comparison with the walls below, with the result that the latter appear to be in gloom whilst the cove in contrast gives an impression of glare. Other advantages of the system are that relatively few units need be used, and that the light can be projected to any distance within the limits of the largest building. Hence conveniently accessible positions may be selected for the fittings, and cleaning and maintenance is simplified. There is also no difficulty in introducing the colour element when desired.

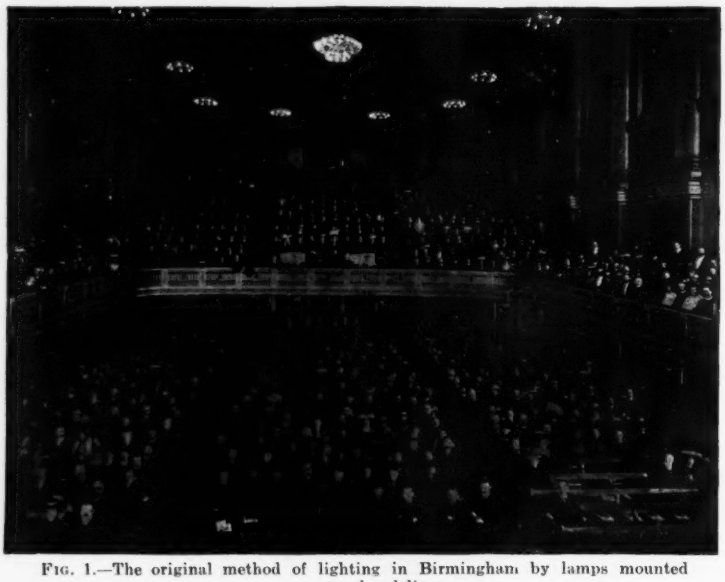


FIG. 1.—The original method of lighting in Birmingham by lamps mounted on chandeliers.

After these introductory remarks let us turn to the various installations. The first of these is the Birmingham Town Hall. In Fig. 1 we have a view of the hall as originally lighted, i.e., by the conventional method of masses of lamps mounted in chandeliers. There should be no need to emphasize the drawbacks of this arrangement—the constant glare in the eyes of the audience coupled with inadequate illumination of the platform and auditorium.

In Fig. 2 we have a view of the same hall showing the present method of lighting. The only lighting units in the body of the hall are single lamp reflectors, one on each of the window sills behind the balconettes, the latter screening the lighting devices completely. The hall is 130 ft. long, 65 ft. broad and 65 ft. high. Twenty 750-watt lamps are used, the reflectors directing high power beams to the bed of the ceiling, some 50 to 60 ft. away. The ceiling therefore becomes the effective illuminant which lights the whole hall and, the luminous area being so extensive, the shadows on the ornamentation are soft and graduated, and, moreover, are thrown *downwards*, the correct direction for showing up architectural detail in its true proportions.

The improved appearance of the hall by the new system of lighting may be judged from the accompanying illustration. Moreover the current consumption and lamp replacements show a saving of about 50 per cent. as compared with the original installation with ceiling pendants.

In Fig 3 is shown a somewhat similar interior—the Newcastle City Hall, for which Messrs. Nicholas & Dixon-Spain are the architects. Indirect lighting is again adopted, but in this hall octagonal pendants contain the devices which project the beams to the ceiling. This hall measures 162 ft. long, 80 ft. wide, and 45 ft. high. Thirty-two 500-watt lamps are used, and an average reading of 14 foot-candles is obtained on the floor level. In addition to this scheme of general lighting soft beams of light are thrown through two of the roof laylights to the platform, giving an additional light on the artistes and creating a beautiful and almost magic effect from the auditorium.

The fourth illustration (Fig. 4) shows the American Bar in the Piccadilly Restaurant, London. The same system of lighting is again employed, but in this case the lighting units are concealed in decorated shell fittings on the walls. This picture is interesting by reason of the very soft effects secured, and the absence of any abrupt hard shadow-line at the level of the fittings.

The final illustration picture (Fig. 5) relates to the Cavendish Hotel Eastbourne. In this installation, which was carried out for the wiring contractors (Messrs. Engineering Works Ltd., London) by the author's firm, indirect lighting was again adopted, but the devices were contained in two vases standing on floor pedestals. The lighting is evenly distributed over the ceiling, which diffuses a soft and ample light to every part of the room.

A feature of all these installations is the complete absence of glare, even when illumination of the order of 20 foot-candles are realized. This point is of some importance in view of the modern tendency towards higher illuminations. It has frequently been pointed out that the eye can only benefit from these higher illuminations provided they do not involve additional glare. In the case of the system described in this article glare remains absent, however much the illumination is increased, because the *relative brightness* of visible surfaces does not vary when the total volume of light is increased.

In determining the best method of introducing this system of lighting the architectural features of the interior must be carefully studied. It is no exaggeration to say that under no other lighting conditions, not excepting daylight, can architectural detail inside a building be seen to better advantage. But it must be borne in mind that powerful beams of light are used. Consequently the method of introducing this system of lighting must be decided by those experienced in it. Moreover, when a new building is being constructed it is most desirable that the architect should confer with the lighting engineer in the early stages of the design. This point cannot be overemphasized, as many difficulties could be avoided by such conferences.

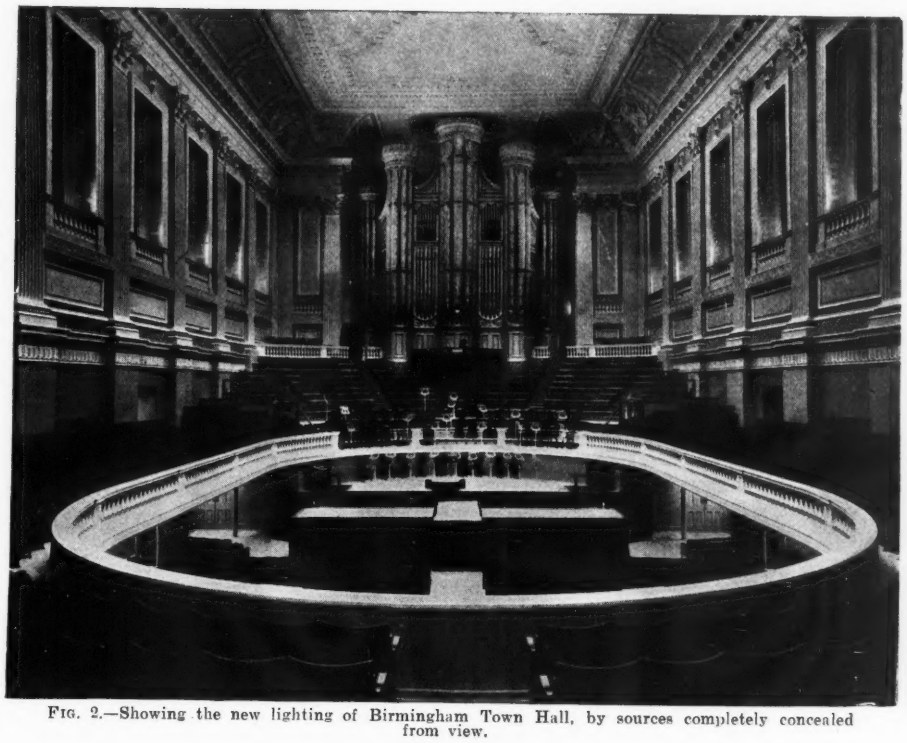


FIG. 2.—Showing the new lighting of Birmingham Town Hall, by sources completely concealed from view.

FIG. 3.—The lighting of Newcastle City Hall. Octagonal Pendant fittings project beams of light on to the ceiling, and diffused light is also directed from the roof on to the platform.

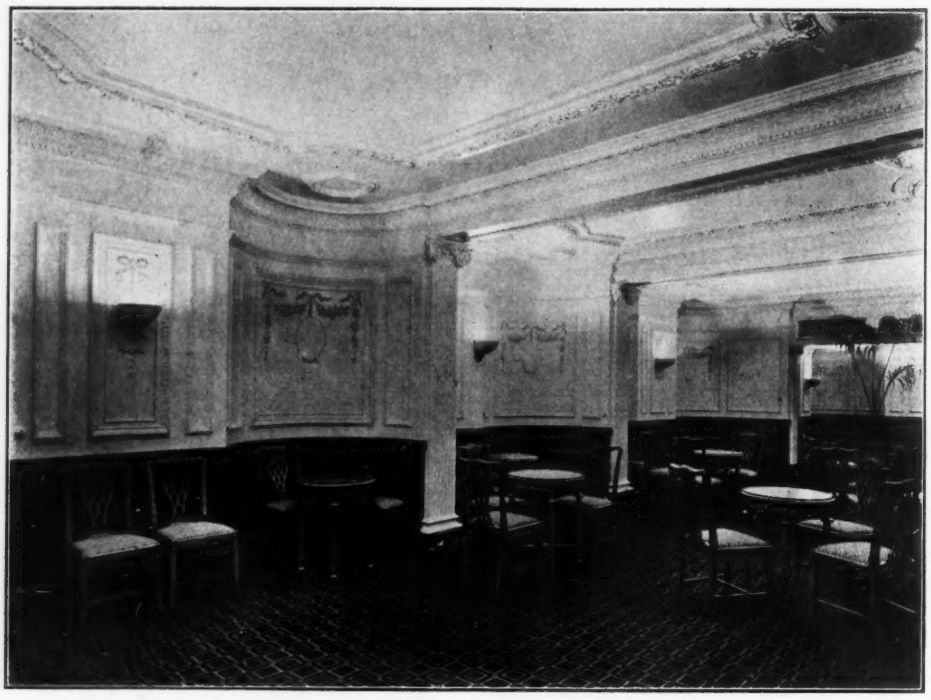


FIG. 4.—Piccadilly Restaurant, American Bar Extension, lighted by indirect units mounted in decorated shell fittings on the walls.

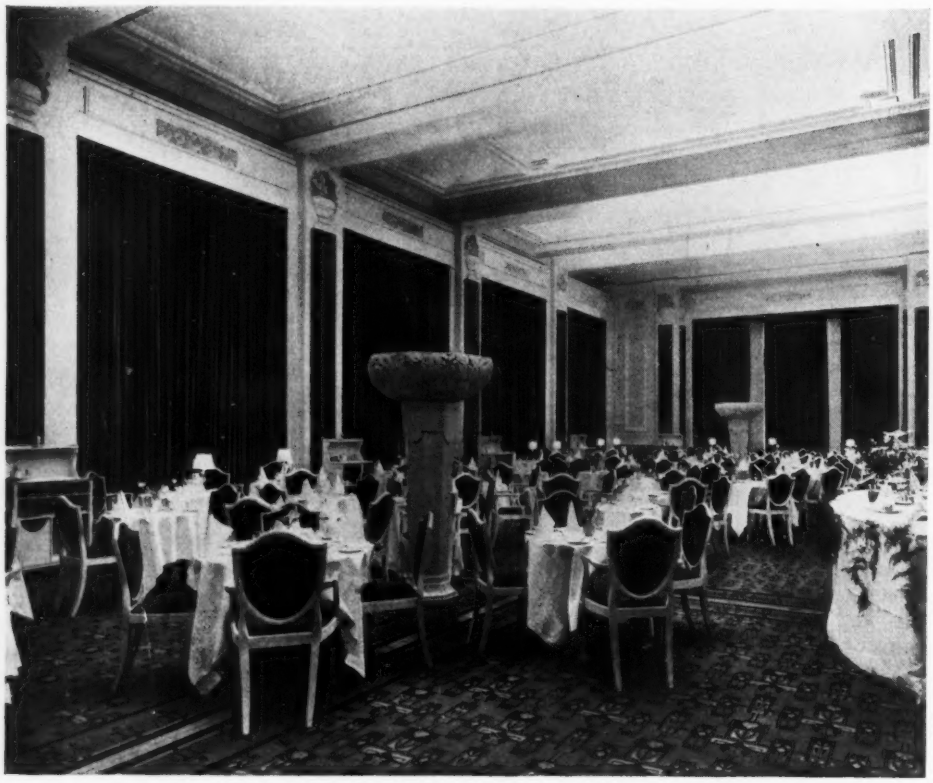


FIG. 5.—The Dining Room of the Cavendish Hotel, Eastbourne. In this case the lighting units are concealed in two vases standing on floor pedestals.

Floodlighting in Germany

FROM time to time many charming illustrations of floodlighting in this country have been published. This system of lighting doubtless developed most rapidly in the United States, but there are to-day many fine examples in Great Britain. On the Continent, apparently, floodlighting was not at first taken up very extensively, but during the last few years there has been great activity. We referred recently to some effective examples in Paris, and in Germany it has formed a leading feature of the " festivals of light " organized in Berlin and numerous other cities.

By the courtesy of the *Siemens-Schuckert Review* we are reproducing a few out of a number of striking installations recently described in that journal. Our first illustration shows the floodlighting of the National Gallery in Berlin. An interesting feature of this installation is the manner in which the columns " stand out " against the illuminated background. The National Gallery in London would obviously lend itself to similar treatment. The application of this method of lighting makes a striking picture, but it also illustrates a point of interest to architects—the reversal of the conditions of brightness and darkness. By natural light pillars appear as light objects against a darker background. With lights concealed behind the pillars we get the reverse effect. By floodlighting from the front it might be possible to imitate daylight conditions approximately, but the degree of contrast would be less and the effect would probably be less spectacular.

In Fig. 2, which shows a night view of the Town Hall at Munster, we have, apparently, a combination of the two methods. That is to say, the building as a whole is floodlighted from the front, and stands out against the dark sky, but the interior of the arches at the foot of the buildings appears still brighter. We think that few people would deny the improved appearance by night of a street or square when adjacent buildings are floodlighted in this way. Such treatment goes a long way towards eliminating the extreme contrast between the public lamps and the dark surroundings, which is one of the greatest drawbacks of present methods of street lighting.

FIG. 1.—Floodlighting of the National Gallery, Berlin.

Our third illustration shows a somewhat different application of floodlighting, for the illumination of fountains in the gardens in Berlin. In this case a combination of white and coloured light was used. Similar methods have been used at exhibitions in England (the lighting of the grounds of the British Empire Exhibition at Wembley was a notable example), but they have not as yet been made a permanent feature in our parks—though there seems no very potent reason why they should not be!

From the contribution of the Editor of the *Siemens-Schuckert Review* we gather that in Germany series of

FIG. 2.—Floodlighting of the Town Hall, Munster.

floodlighting units, employing lamps from 100 up to 3,000 watts, are in use for floodlighting at ranges of 10 to 200 yards or more. The angle of diffusion varies between 5° and 18°, but can be increased to 45° by the use of suitable lenses. For close work (5 to 20 yards) units equipped with white-enamelled reflectors, giving a spread of 120°, are available. In floodlighting and concealed lighting generally much depends on the position available for the projectors. Probably the finest effects of all are secured when the face of a building is deliberately planned to facilitate floodlighting, and suitable arrangements for the mounting of lighting units under canopies, etc., are contrived. The effectiveness of the lighting depends to a great extent on the completeness with which the " works " can be kept out of sight. As yet, however, it is only occasionally that this perfection can be attained, and the lighting engineer is not infrequently much hampered in his choice of sites for projectors. In some cases projectors can be mounted on neighbouring roofs or assembled in a basement at the foot of the building. On the Continent it seems to be quite a usual practice to mount the projectors on poles, or even on existing trolley-wire standards, adjustable brackets being provided to enable the beam to be trained on the surface at the angle giving the most uniform brightness, an arrangement which, one imagines, would not often be sanctioned by the authorities in this country.

In Germany, as in this country, the floodlighting of leading stores and commercial buildings is quite usual. But it is interesting to observe that floodlighting is not confined to buildings of this description. Town halls, cathedrals and other buildings of distinction were lighted up during the recent festivals of light. If local and civic authorities in this country could be interested, we think that the application of floodlighting would rapidly become more general.

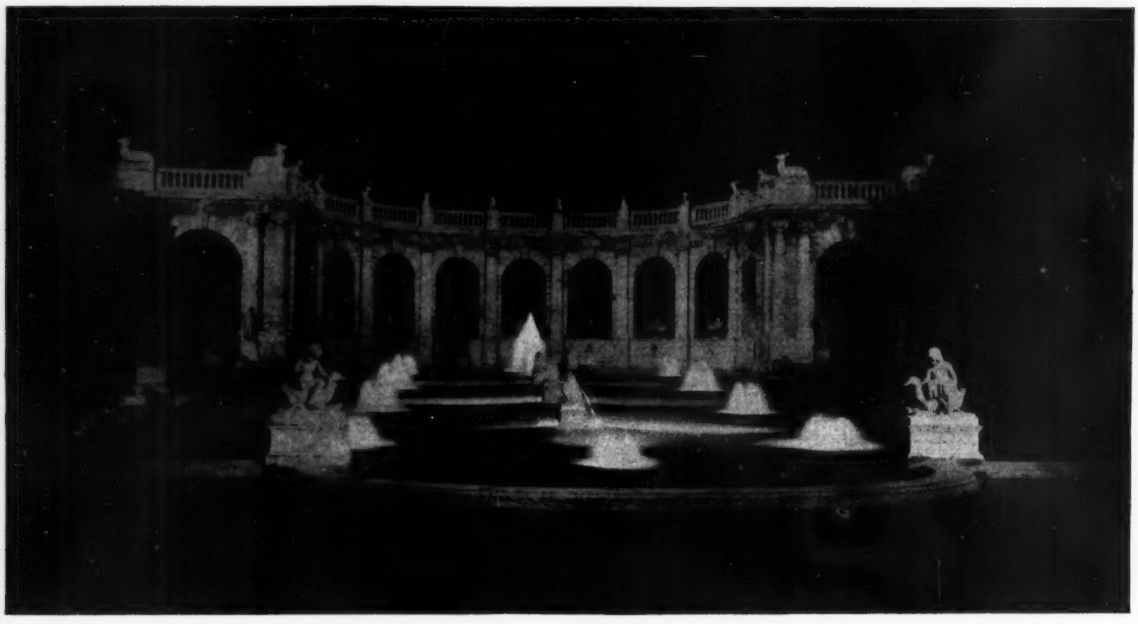


FIG. 3.—Floodlighting in Colours of the "Fairy Fountain" in Berlin.

A New Traffic Light for Pedestrians

An ingenious device described in the *Transactions* of the Illuminating Engineering Society (U.S.A.) has been introduced in Detroit to aid pedestrians in crossing busy streets. Hitherto the green light (which controls the motions of motor vehicles) also served to convey that the road was free for pedestrians to cross over. It not infrequently happened, however, that they would be caught in the middle of the street when the light changed. A police traffic survey showed that it took 17 to 19 seconds for the pedestrian to cross. The new signal now adopted shows whether the pedestrian has time to get across before the light changes. It consists in a 24-inch circle attached to the present light standards at a height of seven feet. When the green light has been on for 10 seconds the light shows a further signal, "Pedestrians Stop—Too Late to Cross," and the wise man accordingly waits until the green light changes and reappears again.

An Essay on Street Lighting*

By G. B. v.d. WERFHORST

PRIOR to the introduction of the incandescent electric lamp for public lighting streets were lighted mainly by incandescent or electric arc lamps. Both these methods resulted in the construction of special fittings which hardly ever incorporated a *completely closed globe*, and in the first instance incandescent electric lamps were installed in existing fittings. Ultimately special fittings were designed for this type of lamp, but until a few years ago they were designed upon the same principles as those applying to the older fittings intended for gas lighting. Even to-day there has not been a very extensive departure from the earlier designs. (See Fig. 1.)

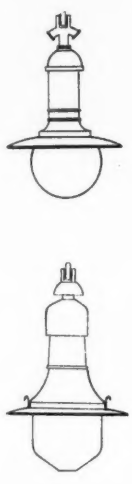


FIG. 1.—Typical Fittings equipped with Globes.

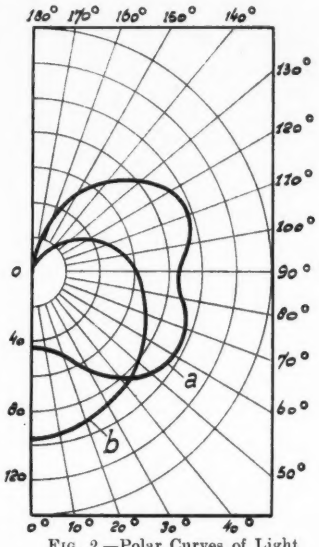


FIG. 2.—Polar Curves of Light Distribution.

The distribution of light from such a fitting differs but little from that of the incandescent lamp itself. (See Fig. 2.)

This distribution of light between two street lamps gives rise to uneven ground illumination. In Fig. 3 the illumination at each point is set out vertically. In curve (1) the illumination beneath the lanterns A and B is rather high; in the portions between A C and D B it remains fairly good, whereas between the points C and D it is very much reduced. The part C D shows a very small luminous intensity, the so-called " light-pit."

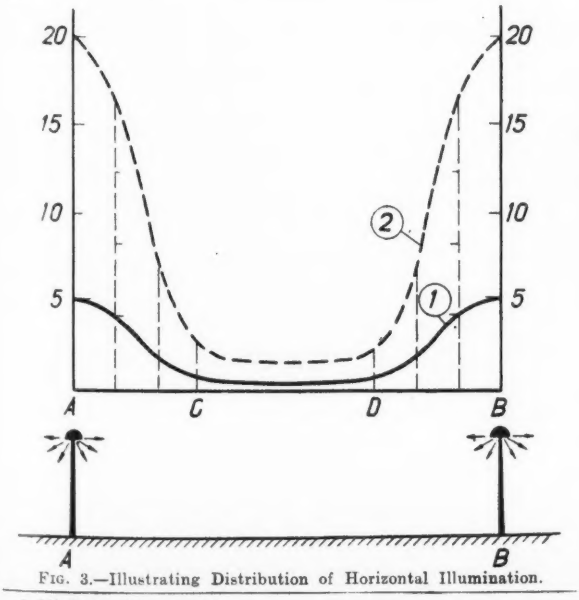


FIG. 3.—Illustrating Distribution of Horizontal Illumination.

* Slightly abbreviated.

A further examination of this question shows how the " light-pit " (dark spot) C D between two lanterns is modified (1) when the distance between two lanterns is reduced; (2) when the mounting height is increased.

The development of the incandescent lamp made it possible to use sources of high candle-power. By providing the lanterns at A and B with incandescent lamps giving a candle-power four times as high as that formerly provided, the illumination on the ground also becomes four times as large. The result, shown in curve 1 (Fig. 3), is now represented in curve 2.

Proportionately the dark spot C D shown (curve 2, lamps of higher wattage) appears less pronounced than before (curve 1, lamps of lower wattage).

To an actual observer, however, it gives quite another impression, and he sees *differences*, i.e., there is too much light in parts A C and D B and too little in part C D. To all appearances the part C D became darker than before.

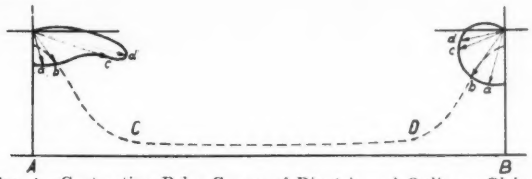


FIG. 4.—Contrasting Polar Curves of Dioptric and Ordinary Globes.

In endeavouring to correct this inconvenience, makers of fittings recognized that the old types of fittings projected too much light in directions *a*, *b*, etc. (see Fig. 4) and too little light in directions *c*, *d*, etc. The desired conditions were obtained if less light were emitted in directions *a*, *b*, etc. (see Fig. 4, dioptric globe).

These considerations led to the design of fittings such as those indicated in Fig. 5 (dioptric globe with curve of luminous intensity). These are *diffusing fittings, but concentrating the light at angles slightly below the horizontal.*

The effect on the *spectator* was that he no longer saw dark spots between the lanterns, i.e., there was apparently greater uniformity in the appearance of the lighted street.

Measurements of the resultant illumination at ground level are indicated in Fig. 6, where curve 1 relates to the old fittings and curve 2 to fittings with a dioptric globe. The data shows that in reality there was but a slight improvement in the region C D; there still remains a depression, even when dioptric globes are used.

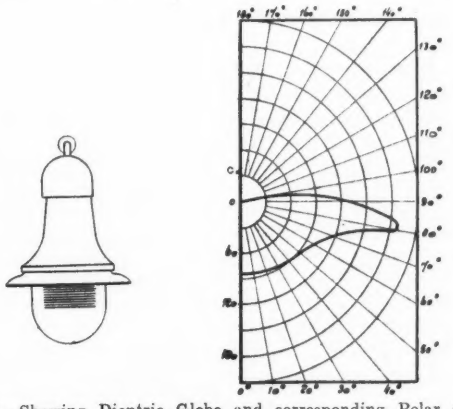


FIG. 5.—Showing Dioptric Globe and corresponding Polar Curve of Light Distribution.

How, therefore, can the impression of uniformity of illumination received by the observer be explained? One possible explanation is that with the new fittings (dioptric globes) his vision became less acute. He was to some extent dazzled and the sensibility of his eye to contrasts was diminished. Hence the impression that uniformity was greater than in reality.

It should be realized that the spectator, pedestrian or coachman, tram or taxi-driver, generally looks before him in a horizontal direction. Now the human eye is especially sensitive to light received at angles of less than 30° (see Fig. 7) with the horizontal. As we generally look directly forward, the eye is chiefly sensitive to light falling within 15° above and 15° below the horizontal line of vision. The light from the sources 1 and 2 in Fig. 7 will therefore trouble us very little, while light from sources 3, 4 and 5, 6, etc., may

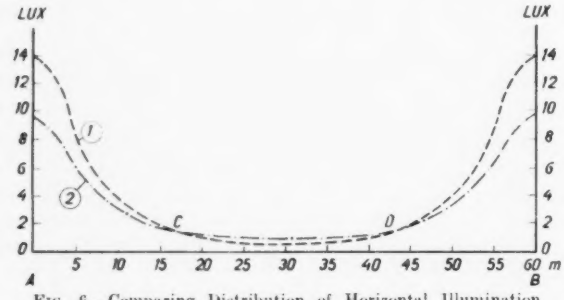


FIG. 6.—Comparing Distribution of Horizontal Illumination with Dioptric and Ordinary Globes.

do so very much. A familiar illustration of this principle is afforded by the sun, which, when high in the sky (direction point 1) does not trouble us, whereas its reflection on water or on the road (direction 5, 6, etc.) causes dazzle. For the same reason the brilliant midday sun, high in the sky, hinders us less than the feeble evening sun, low in the sky.

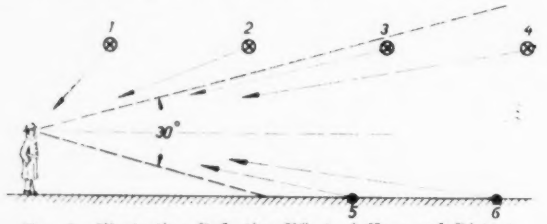


FIG. 7.—Illustrating Reflective Effect of Near and Distant Sources.

The effect of artificial light is, however, worse in this respect, for in this case the source is seen against a dark background, thus providing a maximum of contrast. Imagine a street bounded with lanterns on both sides, mounted at a height of, say, 5 yards. Fig. 8 gives a longitudinal view of such a street. Fig. 9 shows the street in perspective. Consideration of the facts discussed above suggest that we shall not be troubled very much by the sources of light 1 and 2 (Fig. 8), as their rays fall outside the angle of 15°. But, on the other hand, the light from the sources 3, 4 and 5, etc., will give rise to glare. From the perspective view (Fig. 9) we notice that the more distant lanterns appear to blend into one and give the appearance of forming one source of illumination.

The more powerful the intensity of the light emitted in a nearly horizontal direction the greater the degree of dazzle, and this is precisely the form of distribution of light met with in dioptric fittings, as described in paragraphs above, in which the effort to secure uniform illumination involves directly the light mainly at angles slightly below the horizontal. In such cases the majority of the light is concentrated within an angle of 15°, so that the eyes of observers inevitably are dazzled and become relatively insensible to contrasts. Such conditions naturally render it difficult to form a clearly defined image of objects on the roadway in front of the observer.

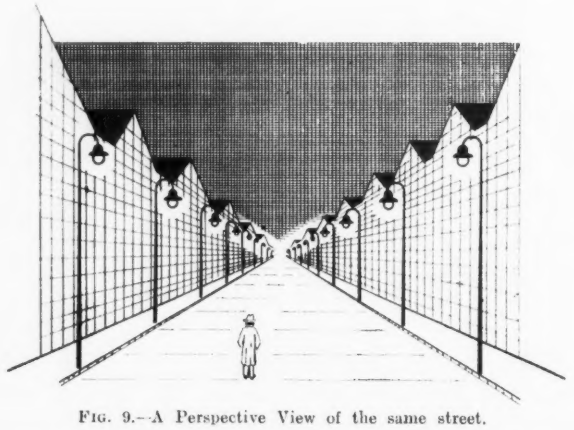


FIG. 9.—A Perspective View of the same street.

In view of the rapidity of modern traffic, the first requirement of safety is that all things on the road be clearly visible. The motor-car driver must not only be able to see at distances of 20 to 30 yards but must also be able to distinguish objects even 300 or 400 yards ahead without difficulty.

For some years these facts have been discussed and considered, with the result that the latest fittings for street lighting are based upon the following considerations.

In order to avoid dazzle, screened fittings which will distribute the light within an angle of only 150° (if need be 160°, see Fig. 10) should be used.

When such fittings are used the street represented in Fig. 8 assumes quite a new appearance. Fig. 11 shows this change in effect. It may be observed that in this case also light can be seen directly by the spectator at A, but as this source falls outside the angle of 15° it does not hinder him. The light from 3, 4 and 5 (Fig. 8) is ordinarily the chief cause of dazzle; but when these sources are screened, as illustrated in Fig. 11, the spectator will not be dazzled. The surroundings will be illuminated, but direct light from the sources does not strike his eyes. This is exactly what we want.

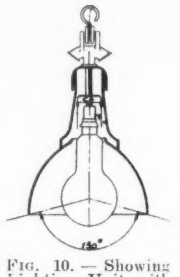


FIG. 10. — Showing Lighting Unit with Rays confined to 150°

Fig. 12 shows a photograph of a street at night lighted by lateral dioptric globes and giving rise to appreciable glare. Fig. 13 shows a photograph of a railway station by night where fittings screening the source of illumination are used. The platforms of grey tiles are brightly illuminated and every detail can be plainly distinguished, even at a considerable distance.

Modern lighting engineers are now disposed to favour so designed fittings that the source of illumination is screened from view. A closed glass globe fitted to an incandescent lamp fitting for street lighting is a relic of olden days. An open dioptric globe with lateral radiation between 90° and 70° (see paragraph 11 and Fig. 5) makes the illumination worse instead of improving it.

Some advantages of the screened source are evident; (*a*) simple construction of fitting, which is easily accessible for either cleaning or for the renewal of lamps; (*b*) higher efficiency of the incandescent lamp, as there is no loss of light in the globe; (*c*) such fittings are less extensive.

Besides these lesser advantages there is, however, the most important advantage of maximum visibility when the source of light is adequately screened. It has been

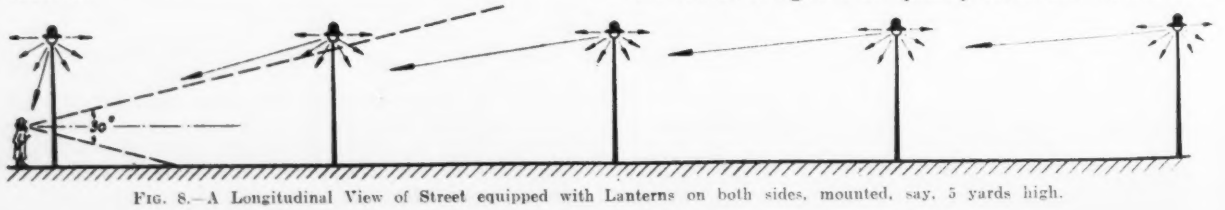


FIG. 8.—A Longitudinal View of Street equipped with Lanterns on both sides, mounted, say, 5 yards high.

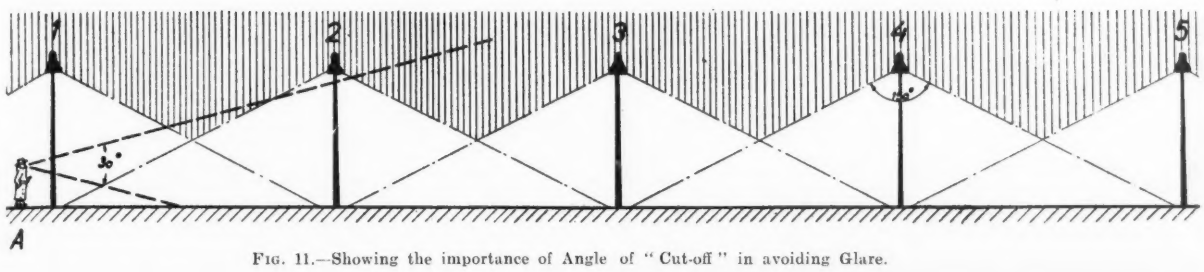


FIG. 11.—Showing the importance of Angle of "Cut-off" in avoiding Glare.

found that in streets illuminated by this method (each lamp of 150 watts) details can be distinguished at 500 yards which are quite invisible when dioptric globes fitted with 300-watt lamps are used.

FIG. 12.—Night Photograph of a Street lighted by Dioptric Globes.

The relations between light distribution, mounting height and distance apart of sources are readily established. With light distribution over an angle of 160° (80° on each side) the sources of light just overlap one another when mounted at a height of four yards and separated by 40 yards. When this distance is increased to 60 yards there is no overlapping. Assuming a mounting height of five yards and a spacing distance of 40 yards there will be 16 yards overlap, whereas at a spacing distance of 60 yards at the same height there will be no overlap. Now assuming a mounting height of 6 yards and a spacing distance of 40 yards, there will be 28 yards overlap, whereas at a spacing distance of 60 yards and the same mounting height the overlap decreases to eight yards.

These considerations emphasize (1) the great advantage of a small distance between the lanterns; (2) the advantage of a greater mounting height.

Fig. 14 shows light-distribution curves for three different fittings: Curve 1, obsolete open-type fitting; curve 2, fitting with dioptric globe; curve 3, fitting with screened light source.

These curves show that the light distribution is not altered very much by the fitting. In all cases, however, there is much light in A C and D B and little in C D.

FIG. 13.—Night Photograph of a Railway Station: all sources screened from view.

The distances A C and D B are almost equal to the mounting height. With a greater mounting height the points P Q and R become lower, whereas the points C and D approach the centre (C' D'). With smaller spacing distances the vertical values above C D become greater. Both factors are favourable to more uniform illumination. Mounting height of five yards and a spacing of 40 yards should be regarded as the lowest possible.

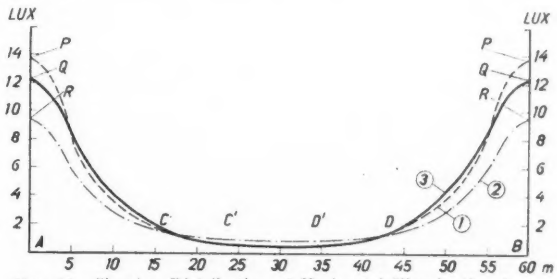


FIG. 14.—Showing Distribution of Horizontal Illumination from (1) Obsolete Open-type Fitting; (2) Dioptric Globe; and (3) Screened Light Source.

Good illumination can only be obtained by mounting at a height of at least 6 yards, with a space of 35 yards between the lanterns.

The street lighting obtained in this way will only be efficient if screened sources of light are more or less standardized to the same pattern throughout. Further, the full benefits to be derived from screening of the light sources will only be realized if this practice is universal.

The Embankment Lighting

We understand that, in the new scheme of illumination which is being carried out on the Victoria Embankment, the Dolphin standards along the parapet are definitely to remain, and will still function as they have done since the Embankment was opened in 1870. The fact that workmen have been engaged in carrying out certain necessary reconstructional wiring details incidental to relamping these units is probably responsible for an erroneous impression that they are to be removed.

The General Electric Co. Ltd., in making this statement, remark that there seems to be some misconception regarding the new system of twin overhead suspended lighting along the roadway which is to be done by means of two 1,500-watt lamps, housed in Wembley lanterns suspended 30 ft. over the roadway. In all there are to be 50 spans, spaced at intervals of 140 ft., each span carrying two lamps. The existing standards alongside the kerb edge of the Embankment are being removed with a view to their ornamental bases being respaced and augmented to accommodate the new stool suspension poles, which will be mounted in such of the existing bases as are at present fixed along the Embankment, and which, bearing the small Dolphin design and the old coat-of-arms, will be retained to accommodate the new poles. As, however, there will not be enough of these old bases, new ones are being supplied of similar design but embodying the new L.C.C. coat-of-arms in place of that of the old type. Thus the Thames Embankment lighting scheme will embrace the ancient as well as the modern.

Lighting Novelties on the Continent

Some Impressions of the Recent Fairs in Leipzig, Vienna and Prague

By A SPECIAL CORRESPONDENT

IT was evident from the extensive display at the Leipzig International Spring Fair that active efforts towards complete electrification are being made in most Continental countries. It is stated that on the average about 50 per cent. of buildings are wired for electricity. The remaineder use either gas or paraffin lamps, the latter, however, being found only in small isolated hamlets and villages remote from the large centres.

The German electrical group initiated an active electric lighting campaign at Leipzig. Interest attaches to the latest small size 10 and 20 watt lamps and to many varied types of lighting fittings—industrial lighting being a special feature. Enamelled iron reflectors are widely used, but there is now a tendency to allow more light to be directed upwards, especially in the weaving and spinning works, where good lighting is regarded as specially important. A number of " artificial daylight " units were exhibited. Most of these were of a familiar type, though one form, equipped with a "sunlight filter" and intended specially for use in the dyeing and textile industries, was of novel design.

Special forms of weatherproof units for use in streets and damp situations have been developed. In humid atmospheres armatures with built-in " Sicheringen " devices are proving popular. In many towns it has been hitherto usual to extinguish all lights at a late hour after traffic has ceased; but methods involving the use of several fittings, some of which can be automatically extinguished at a given hour, are now being introduced. Anti-dazzle lamps suitable for railway crossings formed a feature of the extensive Siemens Schuckert display. Owing to recent accidents to motorists and pedestrians at level crossings there is felt to be a need for well designed lighting units of this kind.

Floodlighting of exteriors of buildings has been making considerable progress in Germany. Some very compact forms of units intended for use at distances of about 60 ft. were shown at Leipzig. The use of light for publicity purposes was also a prominent feature. A novel system exhibited by the Atrax Gesellschaft, of Berlin, involves the use of translucent glass bricks which can be built into the design of a store and serve both for advertising purposes and for illuminating the goods in the window. These bricks are lighted from within and can be furnished in various colours. Name patterns and similar devices can be thus displayed. Another advertising device was based on the use of translucent plates on which designs can be stencilled and which are illuminated by special coloured lamps mounted behind. This is supplemented by flashing neon lights. It is stated that one of these units is to be adopted by a firm in Sydney, where it will be mounted on a tower 240 ft. high. Generally speaking, combinations of neon and incandescent lamps are becoming popular for publicity purposes. Signs based on the use of incandescent lamps but imitating the effect of neon lamps were also shown. Other firms exhibited ingenious methods of building up illuminated signs from individual luminous letters, costing from 25s. to £5 according to the size of the letter (20 to 100 cms.). Electric light signals for shops and hotels were also shown, and the Siemens Schuckert exhibit included a special device for use at railway stations, directing passengers to the various platforms.

For domestic lighting the exhibit of unscreened lamps no longer finds a place in modern practice. Lighting devices assume various novel forms, but a common feature is the complete diffusion of the light.

At the Vienna Fair electric lighting was less well represented and there was not very much in the way of actual novelties to record. Mention might, however, be made of the " Rotax " devices, which included the use of six-sided diffusing cylinders, at the base of which lamps are mounted so that the whole surface is illuminated. Another useful little novelty was a searchlamp fitted with a magnetic plate, which enables it to be affixed to any metal part of a car. This little lamp, which is robust in design, should be useful in examining the mechanism of cars by night.

At the Prague Spring Fair there was evidence that Czecho-Slovakia is now coming to take increased interest in illumination. Recently more lighting publicity has been undertaken. A feature at this Fair was the section devoted to luminous letters in varied forms. Plastic opal glass lettering, illuminated from within, was seen at nearly all the stands, and marble designs and futuristic designs on illuminated backgrounds were much in evidence. One little novelty was the exhibit of an oblong window lamp which can be attached to the glass by the means of suckers. Especially interesting was the display of house numbers executed in prismatic glass, the idea being that such letters should be mounted above the door and illuminated in such a manner as to exhibit the number to persons outside and at the same time give light to the hall. These plates are specially effective when applied to motor cars—the plate being let into the back of the car and the lamp behind illuminating the interior of the car as well as the number. Silhouette writing and colour-changing devices were also on view, and the Municipal Electricity Works had equipped a series of model rooms illustrating the development of lighting in the home.

[This brief note will be followed by a more detailed account of lighting exhibits at the Leipzig Fair, which will appear in our next issue.—*Editor*].

Industrial Uses of Gas

A very comprehensive paper under the above title was recently read by Mr. F. W. Goodenough, C.B.E., at a meeting of the Institute of Fuel Technology. Being read before a body of fuel experts, the paper naturally dealt mainly with heating developments, though some reference was made to the successful use of gas lighting in textile mills and other industrial establishments. The paper presented a remarkable record of the varied applications of gas to different trades and industries—from banana ripening to the vast engineering processes.

Obituary

CHARLES HUNT.

We record with regret the death of Mr. Charles Hunt, who passed away on March 30th at the age of 86. His association with the gas industry extended for over 50 years, and he had a record of service which was probably unique. His early work was done with the London Gas Co., but his greatest achievements were those in the service of the Birmingham Gas Co., later transferred to the Birmingham Corporation. During 30 years of work in Birmingham he was responsible for the introduction of regenerative furnaces, large gas holders and labour-saving machinery, and he raised the Birmingham gas undertaking from a precarious position to one of great prosperity. He occupied the Presidential chair of the Institution of Gas Engineers on three occasions, and he was three times President of the Midland Association of Gas Managers, of which he was one of the chief founders. He contributed a number of technical papers to the Institution, and was also the author of a number of works, of which his " History of the Introduction of Gas Lighting " is perhaps the best known. Mr. Hunt exemplified in a special degree the sterling qualities which one has come to associate with other pioneers in the gas industry, who battled with many early difficulties, saw their efforts ultimately crowned with success, and lived a long life of honourable service.

TRADE NOTES & ANNOUNCEMENTS

THE LIGHTING OF BOURNEMOUTH PAVILION.

The lighting of the new Bournemouth Pavilion, which was opened by H.R.H. the Duke of Gloucester on March 19th, presents interesting features. This building, which has cost about £150,000 and has taken four years to construct, is a good example of modern decorative treatment. It includes, amongst other interiors, a concert hall with a seating capacity of about 2,500, and a dance hall and restaurant, each accommodating about 500. From the General Electric Co. Ltd. we receive some particulars of the lighting arrangements, which have been specially designed to harmonize with the decorative scheme. The adjacent illustration (Fig. 1) shows a view of the 1st class Restaurant, which is lighted with hexagonal fittings, four feet in diameter, executed in amber glass. Supplementary bracket lighting is provided. A feature in the large concert hall is the gilded sunburst in the centre of the domed ceiling, from the centre of which is suspended a four-tier glass fitting, eight feet in diameter, designed to form a multiple star. Four smaller fittings, each four feet in diameter, surround the central pendant. (See Fig. 2.) In the Dance Hall original fittings, equipped with lamps in blue, orange and pearl colours, are used, nearly 400 of these lamps being installed in the room.

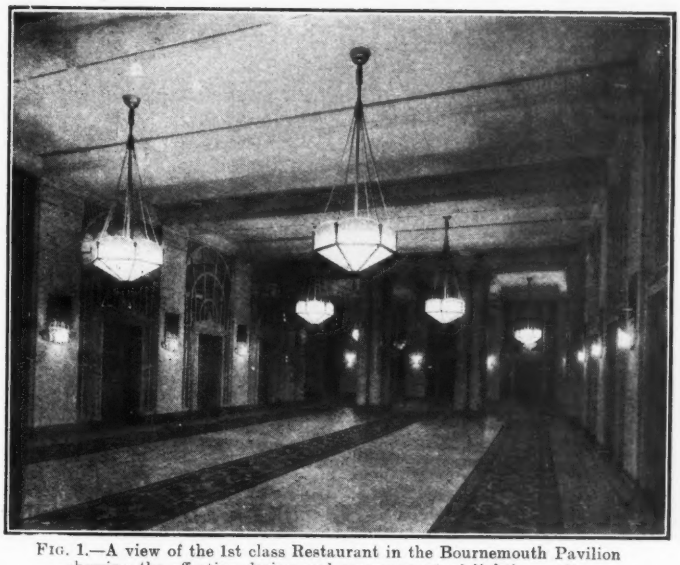


FIG. 1.—A view of the 1st class Restaurant in the Bournemouth Pavilion showing the effective design and arrangement of lighting units.

AN EXPLOSION-PROOF FITTING.

The continued demand for the more efficient illumination of situations in which explosive mixtures are prevalent has resulted in the development of "The Wigan" 100-watt Explosion-proof Fitting illustrated below.

The features embodied to ensure safety are :—

(*a*) Ample mechanical strength (to withstand the destructive effects of any internal explosion) and

(*b*) A pressure release device (so that there is no possibility of the ignition of external gases).

The pressure developed is dependent upon the nature of the gases, and this fitting has successfully passed tests in methane-air, pentane-air and acetone-air mixtures.

These tests have been carried out by Sheffield University forming the subject of Certificates Nos. 227 and 243. The total number of explosions carried out on the sample fitting submitted was twenty-three, without damage. The aforesaid tests prove the safety of these fittings when used in petrol depots, cellulose works, mines, etc. The manufacturers, Messrs. Heyes & Co. Ltd., Wigan, will be pleased to forward copies of the tests to interested persons.

LONDON ELECTRIC FIRM.

EXHIBIT AT THE NORTH-EAST COAST EXHIBITION.

We understand that a feature of interest at the North-East Coast Exhibition is the installation of two very large searchlights, which are mounted on high towers, and have been supplied by the London Electric Firm, in conjunction with Messrs. C. A. Parsons & Co. Ltd., in accordance with the requirements of Messrs. Mountain Wood & MacLean, consulting engineers.

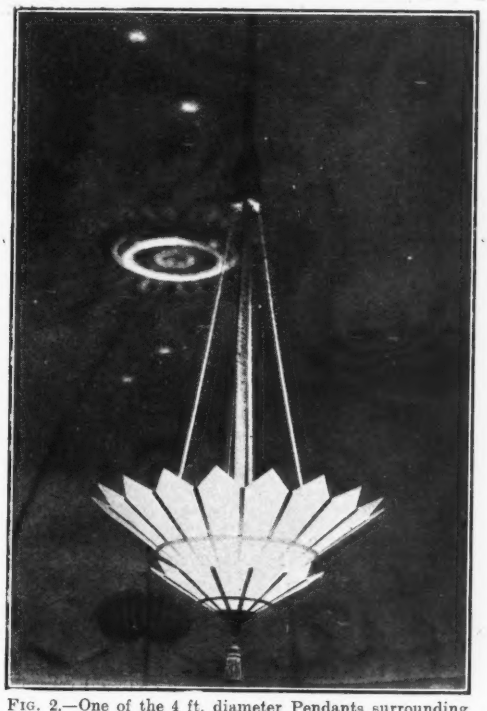


FIG. 2.—One of the 4 ft. diameter Pendants surrounding the central unit in the Concert Hall in the new Bournemouth Pavilion.

CONTRACTS CLOSED.

The following contracts are announced :—

MESSRS. SIEMENS ELECTRIC LAMPS AND SUPPLIES LTD. :—

Local Government and Public Health, Trades Department, Dublin; for the supply of various types of Siemens electric lamps for a period of six months.

City of Belfast Electricity Department; requirements of electric lamps for one year.

INCANDESCENT ELECTRIC " PEARL " LAMPS.

A Welcome Reduction in Prices.

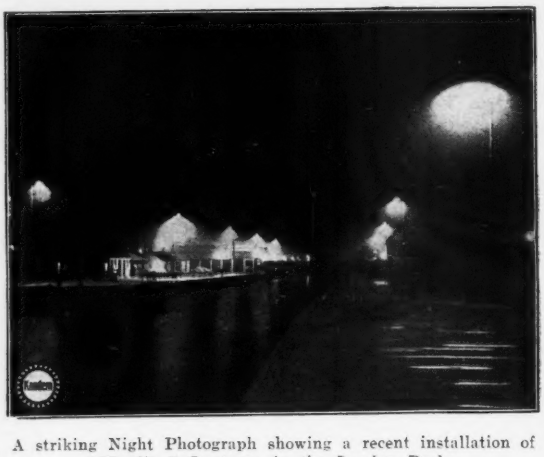
The reductions in the prices of " Pearl " (internally frosted) lamps, announced to take effect from April 2nd onwards, are very welcome. The increasing demand for lamps of this type has enabled the members of the E.L.M.A. to reduce the price of 15, 25, 40 and 60-watt " Pearl " lamps from 2s. 2d. to 2s., and in the case of the 100-watt lamp from 4s. 3d. to 3s. 5d., for 200, 210, 220, 240, 250 and 260 volts. In the case of 15–60-watt lamps for 230 volts an additional reduction of 1d., making the price 1s. 11d., is announced.

This diminution in price of rather more than 10 per cent. may be attributed largely to the popularity of the new type of internally frosted lamp, which, from the illuminating engineering standpoint, marks a distinct advance over the bare lamp in the sense that glare is greatly diminished. It will be readily understood that concentration on the manufacture of this standard type means cheaper production, and we observe that still further efforts are being made to popularize this type. Amongst other steps, a series of lectures on " Glareless Lamps " was delivered by Messrs. W. J. Jones and H. E. Hughes during the past month; London, Glasgow, Manchester, Edinburgh, Liverpool, Newcastle, Birmingham, Cardiff, Leeds, Sheffield and Bristol being amongst the cities covered.

The special reduction for 230-volt lamps is also significant. This is the standard voltage approved by the Electricity Commissioners. Obviously the great diversity of voltages met with in this country has acted as a drawback to lamp manufacturers, and greater uniformity in this respect, by facilitating standardization, should tend to cheapen manufacture.

" ESSALITE " LIGHTING UNITS.

Messrs. Smith & Ansell (Birmingham) have recently issued a leaflet drawing attention to the simple devices incorporated in the " Essalite " units supplied by this firm. Since the introduction of the gasfilled lamp there have been several developments in lighting units, the open bowl being to a great extent replaced by the enclosed diffusing unit, which usually consists of a metal canopy carrying the enclosing glass globe by its lip. It is pointed out, however, that the usual method of support—the metal canopy engaging with an annular groove in the glassware by means of screws—is not very satisfactory, especially in view of the expansion of the glass when lamps are lighted up and they become heated. In the " Essaylite " unit, therefore, a simple device is introduced to overcome this difficulty.



A striking Night Photograph showing a recent installation of " Throlite " Lanterns in the London Docks.

THE LIGHTING OF DOCKS.

We are indebted to Messrs. Korting & Mathiesen Electrical Ltd. for the above striking picture, showing a night view of a section of the London Docks, where " Throlite " lanterns have recently been installed. One often hears comments on the importance of industrial lighting, but it is to be feared that the lighting of docks is apt to be overlooked. Actually good illumination is here quite as important as in the factory, if not more so. Dockyards furnish an all-night service, and loading or unloading of ships may go on throughout the hours of darkness. Dock lighting, however, presents considerable difficulties by reason of the very large areas that need to be illuminated. It is necessary to make the very best use of the limited light available, and the importance of scientific methods is evident. Amidst such dark surroundings glare is specially objectionable, and all lights should be carefully located and screened from view. Considerable importance attaches to the proper control and direction of light. The above picture gives a good idea of the wide spread of light from the lanterns and the screening effect of the reflectors.

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